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Improved Quadruple Paint Mill—Improved Paint Mill Grinder.

The engravings on this page show some improved machinery for the use of manufacturers of paint, ink and chemicals. The mill for grinding paint is so arranged that from one to four colors may be ground in it without danger of mixing one with another.

It is in reality four mills combined, and so arranged as to be all driven from the one central shaft and single pulley. Levers *B* are provided, by which any mill may be stopped or started without interfering with the rest of them, or the entire machine can be started or stopped by the lever *F*.

The four hoppers shown inside the large one can be taken out when desired and the materials put into the large hopper, the capacity of which is over 50 gallons. Then all four of the grinding runners can be used, if desired, upon the one color. When it is desired to grind different colors at the same time the small hoppers can be quickly and easily put in, requiring no fastening. The grinding runners can be quickly detached for sharpening, and one set of runners can be removed while the others are in use.

The width of the grinding surface has been specially enlarged, so that it is about double the usual amount for mills of the same diameter—the makers claiming that the mill shown is about equal in this respect to eight of the largest sized mills as usually built.

A special feature claimed for this mill is its freedom from heating; water jackets are entirely dispensed with, yet oil or coach color can be ground without danger of heating. By an improved device the runners are made to revolve with every part of their surfaces in full contact, which, of course, adds to their efficiency, and often obviates the necessity for a second grinding. The gears are covered by a cast-iron apron, which protects them from paint and dust.

The No. 2 mill has four runners 10″ diameter, occupies a floor space 24″×24″, has a hopper with a capacity of 16 gallons, and weighs 750 pounds. No. 3 mill has four runners 16″ diameter, occupies a floor space 36″×36″, has a hopper with a capacity of 50 gallons, and weighs 1,750 pounds.

The other engraving represents a machine designed especially for sharpening paint mills, which it does by grinding with an emery wheel. The machine is so built as to be available for all the purposes of an ordinary emery grinder, being provided with means for running an emery wheel on each end of the spindle, a rest, etc. In addition to this is the feature especially designed for sharpening paint mills.

It is provided with a chuck for holding the sections at the required angle and in the proper position, and can be moved with precision in every direction required for the work. It is raised or lowered by means of the screw working in the nut *D*.

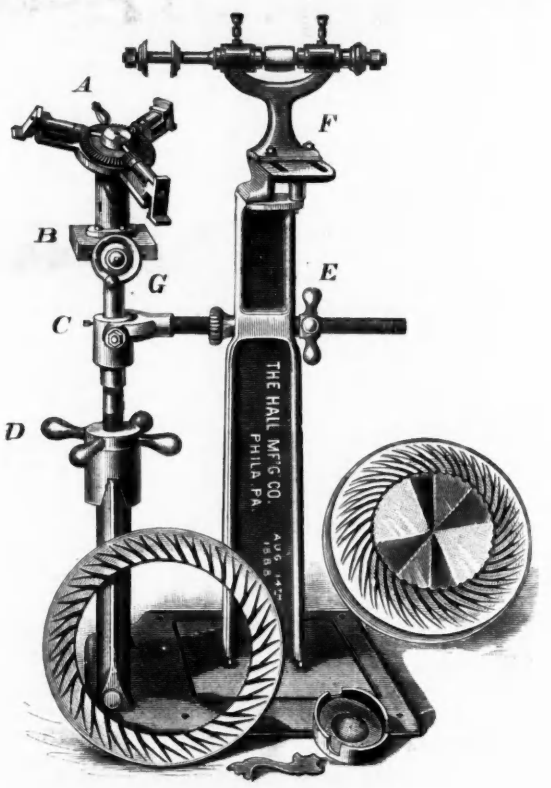
The usual method of sharpening such mills is by hand filing—a method which is not only tedious and expensive, but cannot, of course, equal in precision the work done by such a machine as this.

The spindle boxes are provided with means for taking up wear, and the spindle is held in position by collars, one on each side of the head. The bearings and collars are thoroughly protected from dust and emery by brass caps backed up with leather packings.

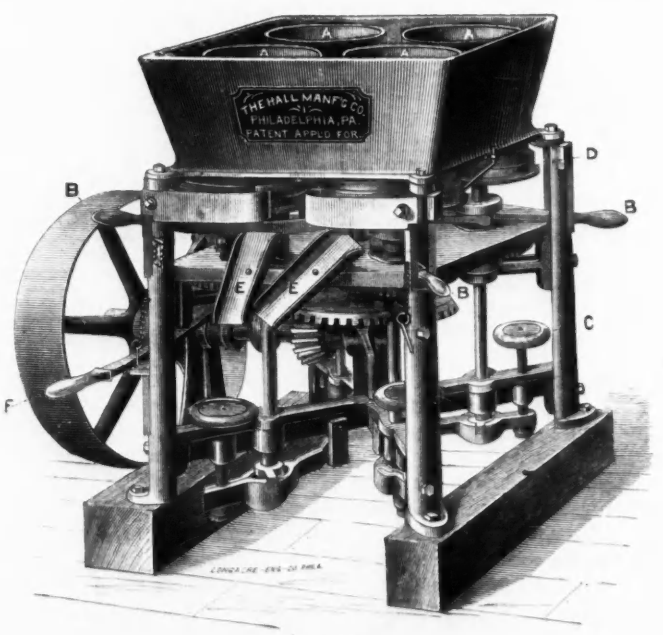
Each machine is provided with a rest for grinding tools, a wrench, a shelf to hold small tools, and one emery wheel.

A countershaft accompanies each machine, which should be run at 450 revolutions per minute.

These machines are built by The Hall Manufacturing Co., cor. 12th and Buttonwood streets, Philadelphia, Pa.



GRINDING MACHINE.



PAINT MILL.

It is stated that there exists a scarcity of ocean tonnage at the port of New York. Although the freights from European ports to this city are reported to have been good, the owners of vessels have preferred shipping to other ports, where a return cargo was more certain. The dull season was brought to a close about six weeks ago, by an active demand for petroleum in England, and the consequent demand for vessels to carry the product from this country. Sufficient tonnage to supply the demand could not be obtained, and freights to Liverpool advanced from 1s. 6d. to 4s. 6d. per barrel.

The result of this scarcity of tonnage is now felt on the grain and cotton service, in which the steamers now engaged in carrying the oil were formerly employed. The active demand for cotton and grain now existing in Europe has advanced the freights on grain from four to six and one-half cents per bushel, and steamers making engagements ahead ask a still higher rate. It is stated that shipments of grain have increased until 600,000 bushels per week are now leaving the Atlantic ports. A remarkable feature of this great movement of grain is the fact that there is no increase in the prices of corn at this port. On July 3, the price was 54¼ cents a bushel, and Sept. 4 the price was 54 cents. The advance in Europe has all been absorbed by the increased rates of freight. The shipments of wheat have not increased in the same proportion as those of corn. In cotton freights the advance has been from one-sixth of a penny to one-quarter of a penny for compressed cotton. The demand for cotton in England is now so great that, aside from the through shipments from the South that are being made, large engagements to ship from cotton held in stock in this city have recently been made.

Fixtures and Tools for Turning and Drilling Balls.

BY FRED J. MILLER.

By far the larger number of machine shops do not have enough spherical work to turn in the lathe to make it practicable to provide the equipment for doing such work, which is of course always to be found in the larger shops devoted to lines of work involving the making of large quantities of such work. Yet most machine shops have some such work to do, and it is often quite an advantage to be able to turn a sphere approximately true, merely for looks, as in the case of balanced handles of machine tools, and do it expeditiously, or, when occasion demands it, to be able to make a sphere practically true, and bore a spherical box to fit it accurately, as in the case of a universal joint or spherical crank-pin.

It is customary to do such work in shops where the necessity for it only occasionally arises, by making a template out of sheet metal, and after roughing out approximately to shape by using the regular lathe tools, to finish to the template by hand tooling, a process which is not only tedious, but, where much exactness is aimed at, is likely to be unsatisfactory.

For such work as handles and round rimmed hand-wheels for machine tools, in shops where they are not made in sufficient quantities to warrant the purchase of the special tools and machines made for such work, it is probably the best plan to use for the final shaping, tools which have been milled or otherwise shaped to conform to the curvature of the work to be turned, and by lapping such tools after hardening in order to restore them to accurate shape, it is possible to do work with them requiring a considerable degree of precision.

Makers of transits, levels, etc., used by surveyors and engineers, secure very nice results in doing spherical work by the use of tools of remarkable simplicity; indeed, so far as I know, the tools used by them for this purpose are the most simple and inexpensive ever devised for such work which at the same time enable very accurate work to be done.

They use them for shaping the bearings for the "tangent screws" used in giving slow motion to the various plates of the instruments in setting the verniers, or sighting upon distant objects. It is made an espe-

cial point to have them work very smoothly and uniformly, and, since the bearing and the nut, in approaching or receding from each other, travel in circular paths, both the bearing and the seat for the nut must be spherical or in some other way made universal. Fig. 1 shows the usual arrangement, where a part of the shank of the screw is shown, having a ball formed upon it which constitutes the bearing. The piece, only a part of which is shown below the ball, is fastened to the plate, and the other piece rests upon it, and is held in place by the small capstan head screw, as shown. Both the pieces have seats formed in them, in which the sphere revolves, and by means of the screw lost motion may be readily taken up.

This is a form of bearing which I believe should be more generally known among machinists, since it will readily be seen that for screws having light duties to perform, requiring universal joints at the bearings which must work very nicely and entirely without lost motion, either laterally or endwise, it possesses many points of excellence; not the least of which is, its comparatively inexpensive character.

The tool used for finishing these balls is shown by Fig. 2, and it consists simply of a round piece of steel, into the end of which a hole is made somewhat less in diameter than the balls are to be; the end is beveled off to form a cutting edge. It is then hardened (for fine work lapped perfectly smooth and round inside the hole), and used as a hand tool in the lathe in the manner indicated in the cut. For reasons which will readily be understood upon a little reflection, it will, when applied to the work as it turns in the lathe and moved around laterally each way as far as possible, and at the same time rotated slowly upon its own axis to keep the wear of the cutting edge nearly even, produce a practically perfect sphere.

The tool used for making the spherical seats or bearings for these balls to work in is shown by Fig. 3, and consists of a shank of steel, slotted at the end, and fitted with a disk of steel which has been turned or ground after hardening, to the size which it is proposed to make the ball. The edges of this disk are left square and quite sharp, and the disk itself is made as thin as is consistent with the work it has to do, and is allowed to turn freely on the pin which secures it to the shank. The bearing which is to be shaped is first located and a hole drilled at its center somewhat greater in diameter than the thickness of the disk; this hole is also usually counterbored as far as possible, in order to lessen the amount necessary to be removed by the disk. The shank of the tool is then put into a drill chuck, and the disk used in the same manner as a rosebit or reamer. It produces beautiful work in brass, not only making it perfectly true, but putting a finish on the surface equal to the finest polish. There is a slight error in the work produced by this tool, owing to the fact that the cutting edges do not exactly coincide with the center; and to reduce this error to the minimum is the principal object in making the disk as thin as is consistent with strength. It is not an error of form, however, but only of diameter; if the center be drilled out, the disk will cut a recess which is perfectly spherical, but of slightly larger radius than the disk itself. I have never had occasion to use this tool for anything but brass, and for the purpose here mentioned, but can conceive of no reason why it would not do good work upon other metals and for larger spheres. It would probably be better, however, if it was to be used for larger work, to make the disk in shape something like a cutter for gear teeth, as in that way the distance of the cutting edge from the center could be reduced to the least possible amount, and yet the thickness of the body of the disk and its bearing on the pin could be made of any desired proportion deemed necessary for strength.

A device constructed upon a different principle, and more applicable to larger work requiring to be accurately formed, is shown in Figs. 4 and 5. It is an attachment to the lathe, and consists of a casting which bolts onto the tool-rest in place of the tool-post, and having a hole bored through it from end to end, into which is nicely fitted a steel shaft, having at its outer end a gear-wheel as shown, which may be driven by the feed motion of the lathe; or it may have instead of this, a worm-wheel and worm which may be driven in the same way, or turned by hand. The end of the casting opposite this gear is provided with a semi-circular flange faced off true, upon which rests a slotted piece, which is keyed firmly to the shaft and carries a small tool-post. The cut, Fig. 4, shows a section of an arbor or shaft supposed to be between the centers of a lathe, and upon which a ball is being turned. It is evident that as the shaft is rotated by means of the gear-wheel at the end, the point of the tool will describe an arc of a circle, the radius of which will equal the distance of the tool from the center of the shaft. If the center of this shaft and the center line of the lathe are in the same plane, the effect of the two circular motions (that of the work upon the centers and of the tool moving about the center of the fixture), is to produce a sphere, the perfection of which is limited simply by the accuracy of the two motions, much the same as the accuracy of ordinary lathe work is limited. The set screw in the end of the slotted piece butts against the lower part of the tool-post and serves for the purpose of a slight adjustment. It would of course be better to have upon the end of the shaft a cast plate equal in diameter to that of the flange upon the main casting, and bearing against it. Upon this plate could be formed a slide, upon which could be fitted a small rest, carrying the tool-post, and moved by a screw. I have chosen rather to show the simplest form which will accomplish the desired result, leaving those who are so situated as to make further development and elaboration desirable to do so at pleasure; in fact, as I first saw it as made by Mr. J. F. Russell, of Springfield, Ohio, it was still more simple; the main casting being nothing more than a square block, picked up and used in an emergency.

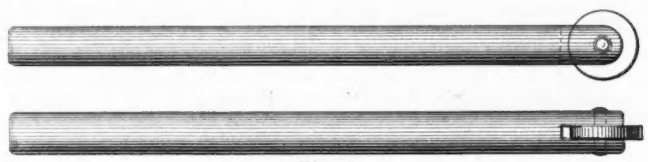


Fig. 3.

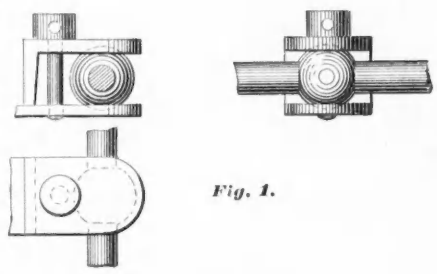


Fig. 1.

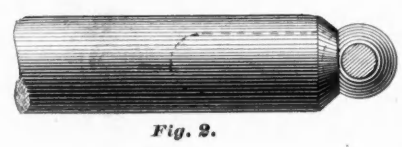


Fig. 2.

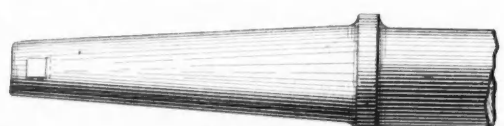


Fig. 6

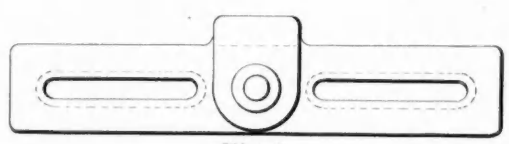


Fig. 9

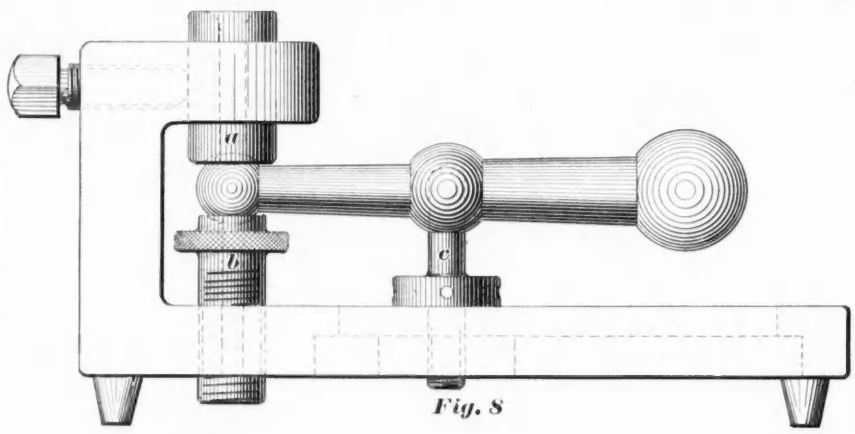


Fig. 8

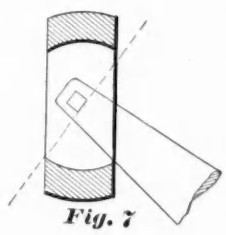


Fig. 7

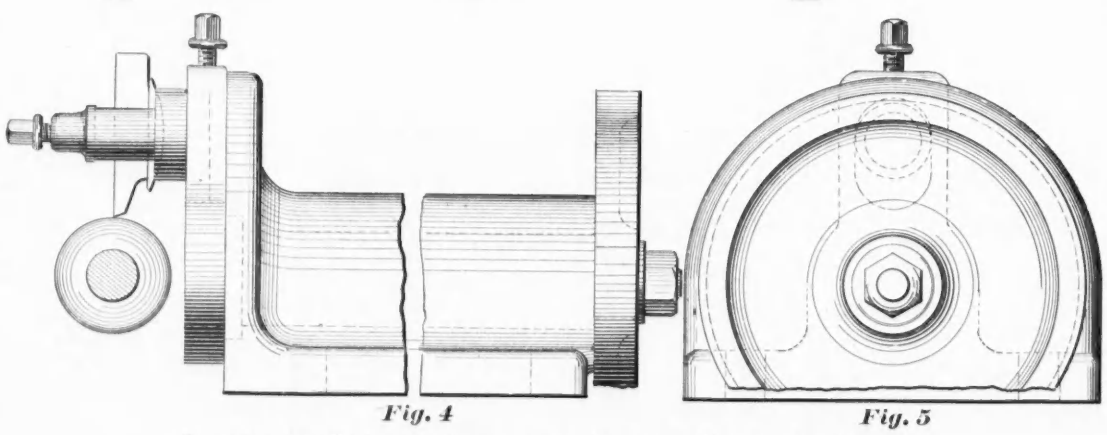


Fig. 4 Fig. 5

FIXTURES AND TOOLS FOR TURNING AND DRILLING BALLS.—SEE PAGE 1.

Of course, so far, the principle involved in its construction is not new, it being rather the embodiment of an old principle in a new form, which, however, possesses some advantages peculiarly its own, among others being its simplicity, ease of application to almost any lathe, and the facility which it gives for adjusting its position accurately by any suitable elevating tool-rest to which it may be fastened. But the most important advantage of this form of ball-turning fixture is the one to which I will now call attention, and which Mr. Russell had in view in its construction.

A ring, the inside of which is a true circle, will fit a true sphere of the same diameter, no matter how the sphere may be turned to pass through the ring. This follows from the fact that *any* plane section of a sphere which passes through its center is a circle equal in diameter to the diameter of the sphere; and for this reason it is not at all essential that the axis about which the tool turns should be at exact right angles to the center line of the lathe; it might be turned considerably to either side of this position, so that in passing over the ball the point of the tool would be vertically over the center of the axis upon which the ball turned at one point only; commencing its cut at one side of the vertical plane, crossing it at the top, and finishing at the other side.

So long as the angle to which it is swung round is not so great as to make the point of the tool fail to touch the arbor or shaft upon which the ball is formed, as it swings over it, it will produce the same results as though the two axes were at exact right angles.

A circular disk of thin metal will fit the inside of a spherical recess having the same radius, in whatever position it may be placed. Now if the shaft carrying the slotted piece and tool-post be removed from the fixture, and the boring bar, Fig. 6, substituted, this boring bar, having a cutter in the slot near the end, the extreme cutting point of this cutter in turning about its center, may represent the circumference of a disk of corresponding radius; and if the end of the boring bar carrying the cutter be put into a spherical recess, and the center of the disk, the circumference of which we have supposed the revolution of the point of the tool to represent, be placed so as to coincide with the center of the spherical recess, and the tool revolved, it will, if set to the right distance from the bar, just touch the surface of the sphere all round, *no matter what plane it may revolve in.*

It is this principle which is utilized by this device in the manner shown by the diagram, Fig. 7, which represents the section of a piece supposed to be chucked in a lathe, and to have a hole or recess formed in it which shall be spherical; or what the geometricians term a spherical segment. The dotted line represents the plane in which the point of the tool revolves and passes through the center of the sphere. I had intended to have a second dotted line representing the center line of the lathe, but either through my own or the engraver's oversight it is not there; but we know that such a line would pass through the center of the section, and would be at right angles to the heavy line on the right and the parallel one on the left.

It will be seen from the foregoing that the bar may lie in a line which is at any angle to the center line of the lathe, limited only by the proportion between the size of the bar and the opening through which it must pass. The nearer it can be brought to a right angle, the greater the proportionate part of a complete sphere can be turned out, but the angle at which it is set will not affect the shape or size of that part which the tool can reach, any more than the position of the thin disk affects its fit in the spherical recess.

Of course the smaller the bar can be made the greater the proportionate part of the sphere which can be bored out, but it needs to be small at one place only, and that is at the point nearest the edge of the hole where it passes through, and, since the bar does not have to make a complete revolution, it can be cut away at this point nearly to the center,

and half way or more around the bar; by this means the proportion of the sphere which can be bored out can be made much greater than shown in Fig. 7.

This device, well made and properly handled, upon a good lathe, is quite efficient and is capable of doing very nice work.

In connection with this spherical subject, there is another matter which is of interest, and that is, the best method of drilling holes in spheres so that they shall center them exactly, and so that, where there are two or more spheres upon one piece to be drilled, the holes may bear the proper relation to and be parallel each with the other. We all know that, compared with the apparent importance of this matter for such work as balanced handles, it is a bothersome job to drill them satisfactorily unless there are some special fixtures for the job, and there are no such special fixtures in the shops, except where there is a good deal of such work to do. Fig. 8 is a view of a jig which I saw in the shops of the Springfield Machine Tool Co., Springfield, Ohio, which they use for this job, and which is so made as to be available for any size or proportioned handle.

The piece, having the hole already drilled in the central ball, is placed upon the stud *c*, which fits the hole and is adjustable in a slot to any desired distance from the bush *a*. Its lower end is threaded, and to it is fitted a nut, which is in the lower part of the slot; the collar is drilled for a pin, by which it can be clamped firmly in any desired position. The supporting piece *b*, is adjusted to the proper height, and its upper end and the lower end of the bush *a*, being beveled in the manner shown, they center the ball which is to be drilled; after which, the stud *c*, and the set screw which holds the bush *a*, are tightened, and thus the piece is located and firmly held in the proper position. Bushings (*a*) having various sized holes may be provided, and also as many different sized studs (*c*) as may be necessary, and you then have a jig which is not only a good one, but is useful for all that class of work.

I do not know how they drill the hole into which the stud *c* fits, but it now occurs to me that perhaps it might be possible to still further extend the usefulness of the jig, and make it available for holes which come at a distance from the end of the piece, by making it in the shape shown in Fig. 9, which is a mere outline of a plan view of the idea. Constructed in this way the piece could extend out either way from the bushing and one of the ends secured in any suitable fastening, which would not necessarily be adjustable vertically, because the adjustable piece *b*, Fig. 8, would serve for leveling the work. Then by having a stud, *c*, Fig. 8, to go into either one of the slots, this jig would of course drill the hole in the end ball, the same as the other one.

Practical Details of Blacksmithing.

BY B. F. SPALDING.

UTILITY OF LABOR-SAVING MACHINES—ADAPTABILITY OF BOLT MACHINES—HAND MACHINE FOR BENDING HOOKS.

A proper regard for economy demands the very severe exercise of well-educated judgment in dictating what tools shall be used for doing any special kind of work. The machine which it would be the very best judgment to procure, for a shop doing a great deal of a certain class of work, would prove a poor investment in a place where it would have but little to do. If a man had only one piece to do, would it not pay him better to chip and file off a surface ten feet square, than to buy a planer for that express purpose? It takes but little simple calculation to determine such points, but that little which it requires is often withheld. But if, for instance, we suppose that a shop has work to do, which if made with tools so inexpensive as to be a trifle not worth considering, would cost the work of one man at $2.00 per day, including fuel for 200 days, and the same man and fuel could, with a machine, do the work in 50 days, there would be placed to the credit of the machine the work of 150 days, or the sum of $300. This would appear, on the face of it, to call for the purchase of the machine without delay, but there are a great many shops which are not crippled for resources, where a problem similar in its terms to this has been brought up, carefully considered, and the decision made that it was not best to make the purchase.

To give an example: a large manufacturing firm, which was itself extensively engaged in making labor-saving machines on which the profits were large, kept three or four men a good part of the time making bolts, when a bolt machine, costing $1,800, would have made all they used in six months at least, without a doubt, saving the labor of two men. If it is necessary, to insure against breakages, to call the interest on the capital invested in the machine 20 per cent., the $360 thus obtained would be something to offset against the extra cost of hand work, but probably the principal reason that prevented the purchase of a machine by this firm was that their demand for bolts was uncertain, capricious and fluctuating. They might want half a dozen different kinds of odd styles or sizes of bolts all at once, without any premonition, and they could get them from the hand machines with less trouble than from the power machine, which, when once "set," would by good rights finish its job before it was changed. Another good reason they had was that these men worked on other jobs part of the time, which made it necessary to have them on hand where they could be called upon at a moment's notice. In most any place where great quantities of work is made up ahead, there will generally be found, after some years, that quite a lot has been thrown aside, as some change has necessarily been made in the machine manufactured, which has rendered some of these accumulated parts useless, and for this reason experienced manufacturers are shy against storing up supplies for future occasion. But for this, there would be less of such things as bolts made by machine makers than there now are, and more of the business would go to the bolt makers, who have cut their prices of late years to most wonderfully low figures.

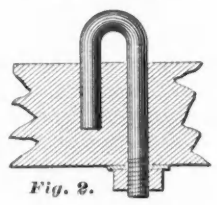
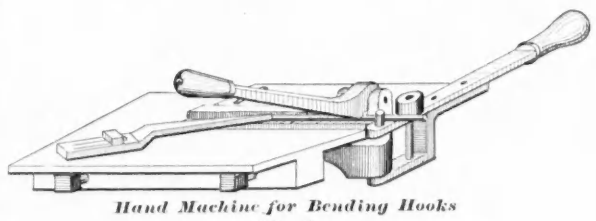


Fig. 2.



Hand Machine for Bending Hooks
Fig. 1.

Machines for making bolts are, however, not exactly what one would call special machines. They are a triple pressure machine, giving pressure in three directions—on the end and vertically and horizontally. Bolts can be made in them, for they are provided with movable clamps to hold gripping dies, and with a resistant to receive the thrust. Many other things can be made on a forging machine possessing these features. The tools used in them may be special tools, but the machine itself is for general use on a large class of work, and is capable of a great many uses to which it has not yet been applied. In this respect its development is like that of another machine, which sprung from the cone and screw machine to the present form of the turret lathe, with all its convenient equipments. But in speaking of special tools, the term is to be understood as applying to such tools as are especially designed to produce a particular form.

Almost every new piece to be made requires some special tools for its multiplication, and the question of how much of the work shall be done by hand or by machinery is sometimes so perplexing as to create considerable expense, before a correct answer is obtained. It often happens that men who are not even experts at a trade will acquire habits by practice, or "get the knack of things," to such an extent as to merit the repute of skill—for skill is not natural, but acquired aptitude—and that this will assist them, by the use of some little helpful devices, to do work with great celerity—which is really very awkwardly laid out. This is the case in the manufacture of things where the little accessories amount to more than the main design.

I have been informed of a job of blacksmithing which has been running for ten or fifteen years on the old original scheme, and has cost from five to eight hundred dollars a year. The piece is made of a bar of iron eight or ten feet long. The tools were made by a man who, although he had no trade, was one of the best mechanics whose works I have ever met. They were made at a time when he had no machine that he could put the work on, and were therefore designed to be operated by hand. Subsequently he procured a machine which was well adapted to doing just that kind of work, and was, in fact, designed expressly for work of that description, and made a lot of tools for it; but not being sufficiently acquainted with the peculiarities of hot iron, there was some reason why he failed to achieve success. He was of the *nil desperandum* make, however, and would have kept at it until he succeeded, as his employer's capital was unlimited, but a too close attention to business brought on disease, of which he died. A year or two afterwards another designer of such things struck the job, and the idea immediately occurred to him also that it would be best to do the job on the machine. He took counsel of others of well merited repute as tool designers, to the same effect; but when he carefully weighed the subject and considered how well and quickly it was done by main strength and the facility of habit, he refrained from hazarding any expenditure, except that of his own ingenuity and time in conceiving plans and working them out on the drawing board without succeeding in producing anything which his judgment approved. The frenzy for having the piece made by machinery, however, was not dead, but sleeping, and about a year ago it woke again with a kick and a start. A very ingenious mechanic, an expert whose business for years had been to devise tools for the work suitable to this machine, was employed to design and superintend the construction of tools for this purpose, and he worked in obedience to orders. But although the main design of the tools he made was correct, there were still some little helpful adjuncts needed, and before these could be constructed—to be used by not over-willing hands—the limited stock of patience was exhausted. As the case stands now, I understand something like a ton of tools were made seven years ago, something like a ton this last year, and yet the job goes on in the old, old way, and the tools would be worth their weight in cast-iron if they could be broken as easily as the original pig. This illustrates the fact that it is impolitic to undertake a job with a machine, unless there is manifest evidence that it can be thus made to decided advantage.

There are some very useful tools of quite general application for particular classes of work, which greatly facilitate the making of it, and which are used by hand. Of these is the little machine for bending hooks, which is shown in the cut, Fig. 1.

These hooks are used in great numbers on agricultural machines, as bolted staples, for making flexible connections. They are used in wood, inserted in the manner shown in Fig. 2. The hole for the short end is bored to the proper depth to allow the staple to project as far as required, when the short end strikes on the bottom of it, as it is drawn in, and tightened by the nut on the long end. The machine is very convenient for bending hooks of any diameter, up to ⅝", although ½" is as large as any one wants to pull around all day, with a lever short enough to work ⅝" with rapidity. The bed plate of this tool is made of cast-iron, and consists of one piece, which forms the plate, to which the working parts are attached, and on this are cast lugs, which run the whole length underneath, for the purpose of fastening it to the anvil. The lug on the back side is not shown, but it is parallel to that on the front side, and is fixed at a distance of six inches therefrom, to enable it to span any common anvil. If it is too narrow, it will not go on some anvils, while if it is wide, it can be blocked up as small as may be necessary. The screws, shown on the front side, are for the purpose of tightening it to the anvil. The projection at the end, through which runs the hinge, which is also the "former" pin, only extends about an inch back on the plate. When the tool is used the beak of the anvil is against this projection. A "roller" may be seen, which turns on another pin, which extends through the lever. This "roller" strikes against the piece which is to be bent, and follows it around with the swing of the lever, which is given to do the bending, thus keeping it up against the "former" pin. The sizes of the pins and rolls are to be varied as required by the various sizes of hooks to be made. As the "former" pin is stationary, it is necessary that the bed on which the stock rests shall be capable of adjustment, backwards and forwards on the plate, to accommodate the various sizes of pins and of stock, which are used. This is accomplished by slotting the holes in the bed, through which the bolts pass which attach it to the plate; the one on the left is seen, partially hidden by the handle of the clamping lever. This lever is hinged between two lugs, which are cast on the movable bed for this purpose. The piece to be bent rests on a ledge which raises it to a level with the top of the lever. The gauge at the back end can be set at any place to accurately determine the length of the hook. The natural tendency in bending the stock around the "former" pin is to pull it away from the gauge, but a pressure on the clamping lever prevents it. As represented in the cut, the machine is now set, with the piece which is to be bent clamped down, and the bending lever in position to swing around and bend the hook. This operation being performed, and the lever swung back, the clamping lever is raised, and the hook removed with the light steel tongs which are used for handling the work, and another piece is taken from the fire, in which a hundred are heating, and being laid in its place on the ledge up against the gauge, the clamping lever is brought down to hold it, and thus the work proceeds. The pieces are bent very rapidly. A naturally quick man, after he becomes expert, can bend from one to two thousand a day, according to size. Where there is not an excessive amount of hooks to be bent, it supplies the place of the very ingenious labor-saving machines, which within a year or two have been introduced to do this kind of work at the rate of from 4,000 to 6,000 a day.

The material known as Woodite, devised by Mrs. Wood, a clever Englishwoman, promises to become a very useful substance. Its chief ingredient is caoutchouc. During the past few months it has given good results for a variety of purposes, and is now declared to be especially adapted to many other uses. According to Sir Edward Reed, M. P., it has been produced in divers forms, such as fine sheets and ribbons for waterproof articles, dense blocks for resisting the blows of shot and shell, and particularly satisfactory rings for engine packing. One process converts into an elastic, sponge-like substance, and another, in which it is mixed with whalebone cuttings, gives it a rough or frictional quality suitable for mats. Some curious naval applications have been worked out. It is made into armor plates, which, on being penetrated by a shot, close so tightly that no water is admitted, and it is also formed into light and convenient cylinders for carrying compressed air to drive lifeboats, torpedo boats, and scout boats.—*Dominion Mechanical and Milling News.*

Modern Locomotive Construction.

BY J. G. A. MEYER.

SEVENTY-FOURTH PAPER.

Main Rod Straps.—In the seventieth paper we have stated that in designing the straps for locomotive main and side rods, about the only calculations which we will have to make are those for finding the correct diameters for the bolts, number required, and the thickness of the strap represented by g, in Fig. 421. For the sake of ready reference, Figs. 421 and 422 are here reproduced.

The rules for finding the number of bolts and the diameters for the same have been given in previous papers; hence it now remains for us to establish rules for finding the thickness of the strap at g.

The weakest part of any locomotive main or side rod strap is in the plane $x\ y$ or $x_2\ y_2$ (Fig. 422), passed through the axis of the bolt. Consequently when the width of the strap is given, the thickness at g must be determined by calculation so as to give a sufficient cross-sectional area in the plane $x\ y$, to resist the forces acting on the strap. Of course in the foregoing remarks we have assumed that the key has the best possible shape for the work it has to do (more of this hereafter), and that its thickness, as well as the diameter of the hole for the oil cup, does not exceed the diameters of the bolts.

The stress* in the main rod straps is greater than the stress in the side rod straps; we shall, therefore, in this paper, consider the strength of the main rod straps only.

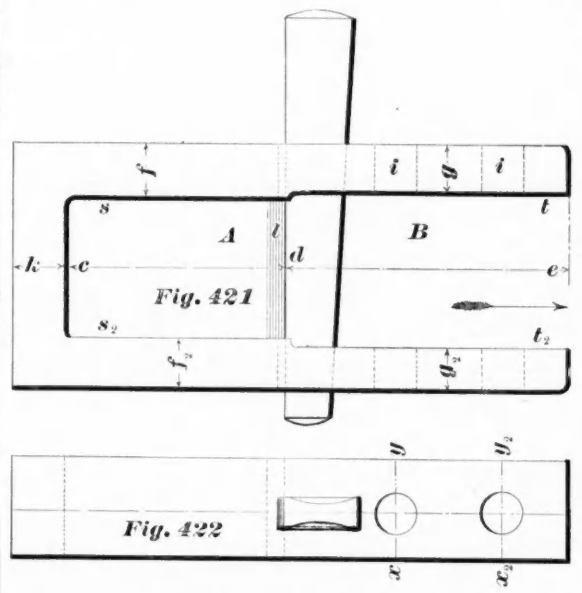
Both the front and the rear straps are subjected to a tensile force, that is, a force tending to tear the straps. But the centripetal force to which the rear end of the rod is subjected brings into play on both straps a force which acts in a direction perpendicular to the length of the rod, or, in short, a transverse force; this force acts with the greatest intensity at the center of the crank pin and becomes zero at the center of the crosshead pin. Yet there are portions of the front strap, on account of their distances from the center of the crosshead pin, which are, more or less, subjected to a transverse force. Also, noticing that the bolts through the straps must necessarily be placed at some distance from the center of the pins, the transverse forces on both straps will act with a leverage, and therefore will act with a greater effect, and cause a greater stress in the straps, than they would do if the bolts had been closer to the center of the pins. Consequently, these latter forces must not be neglected in our calculations.

But the transverse force acting on the rear strap is greater than the transverse force acting on the front one; and since the tensile forces are equal on both straps, it follows that the total stress in the rear strap is greater than the total stress in the front one.

Again, the stress per square inch of cross-sectional area should be the same in both straps, hence it follows that, since the total stress is greater in the rear strap than that in the front one, the former should be made stronger than the latter, and this we often find to be the case in practice. But many master mechanics prefer to make these straps of equal strength, for the following reason: The crosshead pin will wear in time to an oval form, making it smaller in a direction of the axis of the cylinder. If now the brasses in the front end of the rod do not touch each other, as is often the case, and the rod begins to pound, the key may be driven accidentally or carelessly too tight, causing the brasses to bind on the large part of the crosshead pin, throwing on the front strap an extra stress, which may, unless the front strap is strong enough to resist this extra force, cause considerable damage.

There is another fact which must not be lost sight of in proportioning a strap; namely, the bolt holes in the strap will in time wear to an oval shape, and then the holes must be re-reamed, thereby weakening the strap; therefore it is necessary, in designing a strap, to make a slight allowance for re-reaming.

Now in order to determine accurately the thickness g of the strap, we should know the exact magnitudes of the forces to which they are subjected. But to find the exact magnitudes of these forces will be a difficult matter. Hence, taking all the given conditions into consideration, it will be an easier way, and probably the most practical one, to base our calculations on the proportions of



straps used at present in locomotives running at high speeds, doing excellent service.

We have seen that the weakest part of the strap is in the plane $x\ y$. Hence, our first step will be to determine the cross-sectional area of the strap in the plane $x\ y$.

Suppose, for the sake of simplicity, that the strap is subjected to a tensile force, that is to say, a force acting in the direction of the length of the rod, or in a direction indicated by the arrow in Fig. 421, tending to pull the strap apart. In this strap we have two bolts, which we may assume resist an equal amount of the pull, or, in other words, each bolt resists one-half of the pull. We therefore conclude that the metal of the strap in the plane $x_2\ y_2$ has to resist one-half of the tensile force or pull to which the strap is subjected. But the force, acting on the metal in the plane $x_2\ y_2$, is transmitted to the plane $x\ y$, and this plane must also resist the tensile force transmited to it by its own bolt. Therefore the metal of the strap in the plane $x\ y$ must resist the whole tensile force to which the strap is subjected; and the area of this metal must be proportioned accordingly. If we had three bolts through the strap, as is often the case, the conditions would not be changed, that is to say, the weakest part of the strap, namely, its portion in the plane $x\ y$, must be made strong enough to resist the whole tensile force, and treated just the same as if no other portion of the strap had to resist any part of the force acting upon the strap.

If, then, the straps are subjected to a tensile force pure and simple, as we have supposed, we can easily find the cross-sectional area at $x\ y$ by allowing a stress of 10,000 pounds per square inch, as we have done, on the weakest part of a piston rod, and consequently obtain the number of square inches in the cross-sectional area, by dividing the maximum pressure on the main rod by 10,000; the product will be the required area through both wings $g\ g_2$ of the strap.

But we have seen that these straps are subjected to forces acting in a direction perpendicular to the length of the rod, and these forces must not be neglected. But since it is difficult to determine the exact magnitude of these forces, we make allowances for them by reducing the stress per square inch due to the tensile force acting on these straps; that is to say, we assume the straps to be subjected to a tensile force only, and reduce the stress of 10,000 pounds per square inch of cross-sectional area, so as to obtain a larger area.

Here then the question arises, how much stress per square inch shall we allow? For an answer to this question we must turn to the straps at present in use. In these straps we find that the stress per square inch of cross-sectional area in the plane $x\ y$ varies, for the rear straps, from 6,000 to 7,000 pounds per square inch; and when the front straps are made weaker than the rear ones, the stress per square inch for the former is in the neighborhood of 7,000 to 7,500 pounds per square inch. Our experience leads us to believe that a stress of 6,500 pounds per square inch of cross-sectional area for rear strap, and a stress of 7,000 pounds per square inch for the front one, both made of the best quality of hammered iron, is good practice. These figures will be adopted in the following calculations. Hence we have the following rule:

Rule 54.—To find the thickness at g (Fig. 421) of the rear strap on the main rod when the width of the same is given: Divide the maximum pressure on the main rod by 6,500; the quotient will be the required number of square inches in the cross-sectional area at $x\ y$ (Fig. 422). From the width of the strap subtract the diameter of the bolt; the remainder will be the width of the metal at the weakest part of the strap. Divide the required cross-sectional area at $x\ y$ by the width of metal at the weakest part of the strap; one-half of this quotient will be the thickness of the strap at g.

For finding the thickness of the front main rod strap we use the same rule, with the exception that, instead of dividing the maximum pressure on the main rod by 6,500, we divide it by 7,000.

Example 89.—In a locomotive with cylinders 18″×24″, and a maximum steam pressure in the cylinders of 120 pounds per square inch, we find by the method given in the 71st paper that the maximum pressure on the rod is 31,000 pounds; the width of the straps is $2\frac{3}{4}$ inches; the diameter of each bolt through the straps is $1\frac{5}{16}$ inch; it is required to find the thickness of the straps at g (Fig. 421).

The total cross-sectional area at $x\ y$ of the rear strap will be

$$\frac{31{,}000}{6{,}500}=4.76 \text{ square inches.}$$

The width of the metal at the weakest part of the strap, that is at $x\ y$, will be equal to

$$2\tfrac{3}{4}-1\tfrac{5}{16}=1\tfrac{1}{16}=1.8125 \text{ inch,}$$

and

$$\frac{4.76}{1.8125}=2.62 \text{ inches,}$$

will be the sum of the thickness of both wings $g\ g_2$ of the strap. Therefore

$$\frac{2.62}{2}=1.31 \text{ inch,}$$

say $1\frac{5}{16}$ inch, is the thickness of the rear strap at g.

For the thickness of the front strap we have

$$\frac{31{,}000}{7{,}000}=4.42 \text{ square inches}$$

in the cross-sectional area at $x\ y$.

$$\frac{4.42}{1.8125}=2.43,$$

and

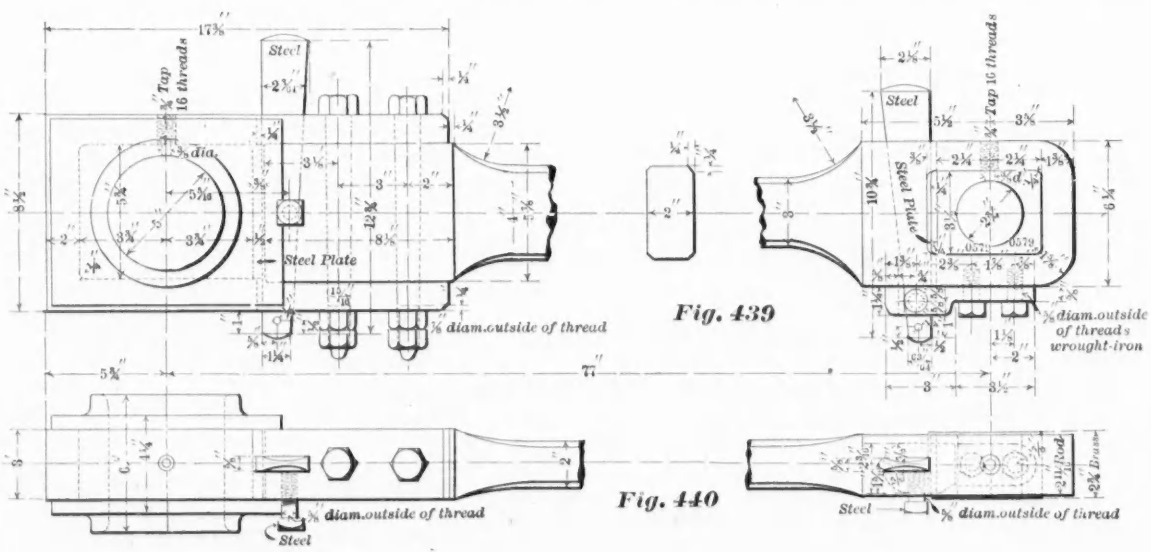
$$\frac{2.43}{2}=1.21 \text{ inch,}$$

say $1\frac{3}{16}$ inch.

Note.—Some master mechanics make the thickness of the front strap equal to that of the rear one; therefore, in such cases, special calculations for the front strap will not be required.

Figs. 439, 440 represent two views of a main rod for a consolidation engine; that is, an engine with four pairs of drivers, and a pony truck, as shown in Fig. 4. The engine for which these rods were designed has cylinders 20 inches diameter and 24 inches stroke, and crossheads like that shown in Figs. 244, 246 and 247.

For a high speed and a maximum steam pressure of 120 pounds in the cylinders, the rear strap on this rod is, in our opinion, too weak; for the above given maximum pressure and high speeds, safer and better results will be obtained by making the thickness of the strap around the bolts at least $1\frac{7}{16}$ inch; and also three $1\frac{5}{16}$ inch bolts should be used in place of two.



The Fortification Appropriation bill,

recently agreed upon by the Senate and House, provides for the expenditure of $200,000 for torpedo defense; $250,000 for steel-hooped mortars; $700,000 for improvement at Watervliet Arsenal; $100,000 for pneumatic guns; also appropriations for guns now being constructed. Altogether the appropriations will amount to about four million of dollars.

India Ink and How It's Made.

India ink hasn't any more connection with India than a good deal of the "dairy" butter on the market has with a dairy. Somebody who didn't know what he was doing named the useful article India ink, but as a matter of fact it ought to be called Chinese ink. To be sure, before steamships and sailing vessels began to ply between China and this country it used to be shipped through India, but the Indians had nothing to do with its manufacture. Thousands of years ago the Chinese were expert in the manufacture of many articles of which Europeans knew nothing. Ink was one of these articles, and was first made of lac, which is a resinous substance deposited by a small insect and

*"Stress" may be defined as the resistance to the alteration of form, and, in this sense, the word "stress" is here used.

largely used in the manufacture of shellac. Afterward a peculiar black stone was found, which could be dissolved in water, and later on lac and fir wood were burned and the resulting smoke gathered on some hard substance, scraped off and rolled into balls. It is one of the traditions of the Chinese that one Tien Tehen invented the process of making India ink some thousands of years before the Christian era. However that may be, a Mongolian named Litchao and his son Liting Kouei went into the ink-making business and turned out about as good ink as has ever been made.

Their successors were not as successful, and for a time the business rather languished. The process now employed by the Chinamen in the manufacture of their India ink is not radically different from that in use in ancient days. The old principle that burning resinous material will throw off thick smoke in large quantities is employed, only the smoke thus obtained is a little more scientifically handled. In the middle of a big porcelain dish, about two feet in diameter and three or four inches deep, they place a stand of about six inches diameter and the same height as the dish. Several small lamps rest upon the stand, and by means of arms fastened to the sides of the dish, small conical dishes are held just over the lamps. The dish is filled with water almost up to the tops of the lamps' wicks and the lamps are lighted. The smoke condenses on the conical dishes hung over the lamps, and is collected in the form of a dense, black powder. This powder is placed in a vase and a warmed mixture of nine parts of fish glue and one of animal glue strained into it through a piece of silk held over the mouth of the vase. The contents of the vase, then being thoroughly stirred, are rolled into balls, wrapped in cloth and immersed in hot water.

Kneading, another immersion, and beating with a hammer follow, the paste is scented, and in the form of long sticks is placed in various shaped moulds. Wrapped in paper, the sticks are placed in a dish filled with rice-straw ashes, and in a day or two are thoroughly dried. Rubbing with cloths and brushes serves to clean and polish them, and they are then ready for the market. The soft paste can of course be moulded in any shape, but as a rule is made into short, slender sticks which are generally ornamented with more or less Volapuk inscriptions or Chinese designs. The peculiar qualities of the ink render it indispensable to sketch artists and draftsmen and nothing has been found to take its place.—*Mail and Express.*

Two-Inch Micrometer Caliper.

The engraving represents this instrument, made by the Brown & Sharpe Manufacturing Co., Providence, R. I. It is shown nearly full size in the cut, and will measure all sizes from 0 to 2 inches, by thousandths of an inch. It is an improvement upon earlier 2-inch calipers, as it measures sizes less than 1 inch, while the earlier calipers did not measure less than 1 inch, but only sizes from 1 inch to 2 inches. The working parts are protected, and means of adjustment are provided to compensate for wear. The decimal equivalents stamped on the frame are very useful, and render possible the immediate expression of readings, in 8ths, 16ths, 32ds, and 64ths.

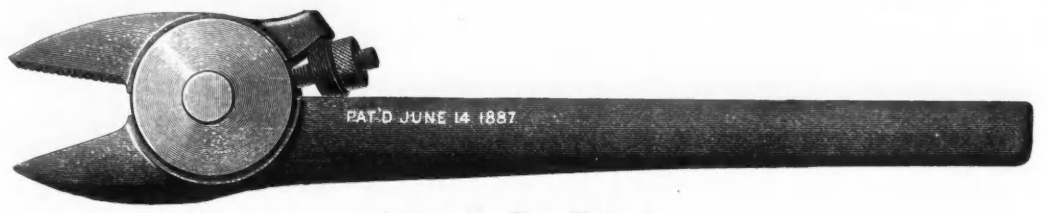
This caliper is also graduated to read to hundredths of a millimeter, instead of thousandths of an inch. When so graduated the table of decimal equivalents is omitted.

A correspondent is desirous of learning of a practical spark arrester for an ordinary foundry cupola. Can any of our readers give him information?

The receipts of British railways this year show an increase of nearly nine per cent. as compared with last year.

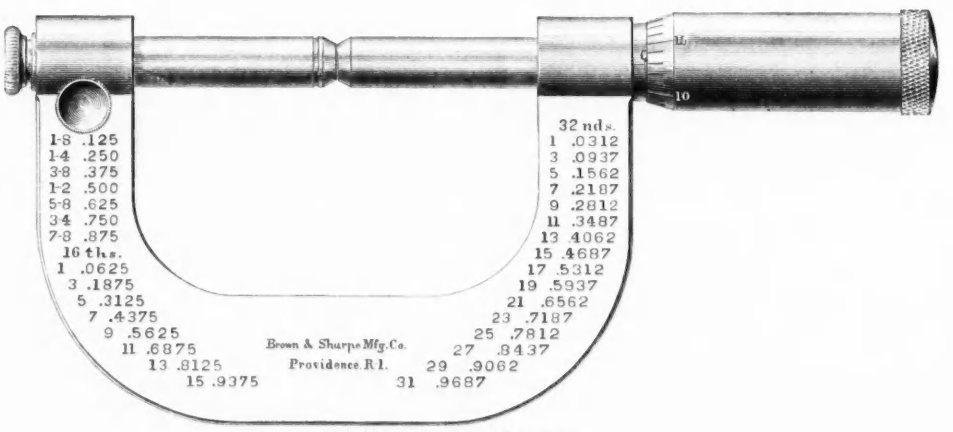
A New Adjustable Pipe Wrench.

In the accompanying cut is shown a novel application of the "alligator" principle to a pipe wrench. The two principal claims for this instrument are that, first, its adjustability of opening permits of any sized pipe within its range being operated upon by the extreme ends of the jaws, facilitating operations where required to be made in close quarters, particularly in corners; second, that it possesses sufficient elasticity to cause it to properly "bite" the pipe, without danger of crushing, such as is encountered in the more rigid, solid alligator wrench. It is, beside, handy in form, and light. It possesses the advantage, also, of permitting of the renewal of a broken jaw at any time without discarding the whole wrench; as the parts are all made interchangeable.



ADJUSTABLE PIPE WRENCH.

The construction is as follows, which will be seen to contain the elements of great strength. The smooth jaw is formed upon the long shank or handle, and the short-toothed jaw, halved on in the usual way of making such a joint. The large washers, however, are rabbeted to the jaws by circular rabbets near the circumference of the washer, and the strains all come upon these circular rabbets, which really constitute a fulcrum of very large diameter; the rivet proper having no other function to perform than to hold the rabbeted washers in place. The small screw oscillates at its inner end upon the rivet, and carries on its threaded end a milled nut, which regulates the opening by the position given it in the wedge-shaped opening formed by the shanks of the long and short jaws. The tool, we are told, has been put to the severest tests, and a considerable number are already in use, giving the best satisfaction.



MICROMETER CALIPER.

It is the invention of E. S. Boynton, and manufactured and sold by the Campbell Printing Press and M'f'g Co., 160 William street, New York.

Shop Notes.

A mechanic going through the shops of the Bridgeport Machine Tool Works, at Bridgeport, Conn., and noting their methods of doing work, and the evident pains taken in the selection and maintenance of tools and machinery, is likely to be impressed with the fact that the works are under the management of a man who, whatever he may be besides in the way of a business man, etc., is first a mechanic, who takes an interest and pride in his business for its own sake, and because it is mechanical. A talk with the proprietor, Mr. E. P. Bullard, strengthens this impression; he is enthusiastic, and evidently takes great pride in his shop and its products—a pride which an examination of the shop, and the work done in it, will prove to be justifiable.

With the class of work they are doing it is, of course, not possible, for reasons well understood by every mechanic, to reduce the manufacture to the complete system of duplication and interchangeability of parts, which is seen in the manufacture of small arms, sewing machines, etc.; but so far as such a system is applicable to machine tool building it is made use of in these shops.

To this end a certain component part of any machine tool is so designed, and other tools so designed with reference to it, that this one part will, without material change, serve for the performance of a similar function upon a number of different machines.

For instance, the complete head stock of a given lathe is adapted to use upon several different styles of turret-head machines, and in some cases is also used on boring and turning mills, such as we illustrated in our issue of August 25, the only change being in the omission of the holes for the change-gear mechanism, and the fitting of a bevel pinion to the end of the spindle—instead of threading it for a face-plate, and boring it for a center. This plan is carried out as far as possible, not only with the part mentioned, but with others as well. By this plan the gauges, jigs, etc., necessary to build a given line of tools are reduced to the minimum, and other advantages secured, both in the manufacture and use of the tools.

This plan makes it possible to provide special tools and fixtures for a certain part of a machine tool, when it would not otherwise pay to do so, and also makes it possible, in many cases, to take considerably more pains, and go to considerably more expense in building jigs and devising special tools and fixtures than would otherwise be admissible.

All the parts which are of such a nature as to admit of it are made by the use of these jigs and fixtures; any part of, or any complete carriage apron, for instance, being interchangeable with any other of the same class, all the holes being bored and reamed in a jig, and the studs, gears, etc., made to standard gauges.

The head blocks are made in the same way; after the holes for the spindle boxes are made it is put into a jig, which fixes its position from these holes by means of accurately fitted plugs; and all the other holes for the back-gear, change-gear mechanism, and those for fastening the head to the bed of the lathe, drilled or bored and reamed before it is taken out. All change-gears are bored and key-seated to fit a hardened and lapped plug, which has a hardened and ground key fitted to it, and a similar system is carried all through the work. Another point which is frequently overlooked in machine shops is fully recognized here, viz., that it pays much better to take the necessary pains to do first-class planer work where surfaces must afterwards be brought down to a bearing by scraping, than to correct by the scraper, work done on poor planers set upon insufficient foundations. Great pains are consequently taken with the planers, and the foundations under them, care being taken to dig deep enough, and put sufficient stone work under them to effectually prevent subsequent settling, or their being affected by the building or the floors in any way. For testing the planers they have some very fine levels, two of them made upon the plan suggested by a contributor to these columns. They have one level which cost $50, and is worth it, as it is a very fine instrument, and is sensitive to an error of .001" in about 14". These levels, in connection with standard hardened straight-edges, are frequently applied to planer beds and ways, to see that they are kept up in proper shape, the result of this care and refinement being apparent in the quality of the planer work done.

Liberal use is made of the milling machine, a number of plain machines and three universal machines being in use in the shop; all small pieces, and such others as the nature of will permit, being milled instead of planed.

A small hydraulic press is used for driving mandrels, and for forcing fits, etc., doing away with the sledge hammer business and being much more effective and better every way.

They are using for drilling deep holes the method shown in our columns March 27, 1886 (with some slight modifications), which consists essentially of a single-lipped twist drill attached to the end of a steel tube. They use it in one of their turret-head machines, letting the tube extend clear through the turret and project as far as may be necessary. One improvement made upon it consists in milling several ridges or steps along that side of the spiral groove which forms the cutting lip; the result being that, when the drill is ground in the usual manner, the cutting lip consists of a number of steps, instead of being a continuous straight line. By this means the chips are broken up so that they give no trouble. The steps are about $\frac{1}{8}$" wide. They have drilled in solid steel, 140 inches, $1\frac{1}{4}$" diameter in ten hours.

As an illustration of the methods employed to secure accuracy in the construction of tools, the plan adopted for boring the boxes for the bearings of the main spindle of the boring and turning mill before alluded to may prove interesting.

The boring of these boxes is left until the housings are in place, and the cross-rail head which carries the tool-bar, feed mechanism, etc., are all in place. Then there is a slide which is in cross-section, an exact duplicate of the tool-bar; it has a rack cut upon one side of it for the feed pinion, the same as the tool-bar, so that it will go into the head and can be handled or fed by the feed motion of the machine in the same manner as the regular tool-bar. Lengthwise through this slide is bored a hole to which is fitted a boring bar. To the upper end of this bar is fixed a worm-wheel, which, by means of a worm shaft and pulley, may be driven from any convenient countershaft. Below, the bar extends down through the bed of the machine and slides through a bushing, which is in a casting having radial arms that bolt onto the under side of the bed or main frame. The bushing turns in this casting with the bar, so that no wear is upon the latter, save that due to sliding. The head is then adjusted so that the bar is exactly at right angles with the cross-rail, the casting supporting the bushing below adjusted to its proper position, and the boring done by cutters inserted in this bar; the regular feed motion of the machine being used for the feed. In this way accurate alignment of the machine is secured with certainty and with little trouble.

Among the new tools to be seen there, we noticed in use in the shop a very powerful 24" turret head chucking machine, which was doing excellent work; it is provided with a friction clutch of peculiar construc-

tion inside the cone pulley and worked by a lever at the left of the operator. Both the cone pulley and the large gear run loose upon the spindle, and by throwing the lever one way, the motion of the spindle is derived directly from the cone pulley, throwing it the other way the motion is taken from the gear. An intermediate position stops the spindle of the machine, though the cone pulley and back gears do not stop.

The front bearing of the spindle of this machine is 4½ x 8 inches, and there is a 2⅝ inch hole through the spindle. It is provided with a chasing bar for cutting threads, and has a six-holed turret 13″ diameter and having a travel of 16″. The turret revolves automatically, the same as a screw machine, but provision is made for suspending this function, so that, when desired, the turret can be fed back and forth without turning it, and the same tool presented to the work repeatedly; a feature which will prove very convenient for many kinds of work.

They are about building a machine for the Buckeye Engine Company, which is an adaptation of the regular boring and turning mill to the special purpose of boring the main hole for the crank-shaft, facing, turning, and boring the wrist-pin hole in the crank disk of their engine. All these operations except the last mentioned can of course be done at one chucking with the regular machine, but the wrist-pin hole is taper, and largest at the back, the pin being put through from the back side. The hole is also counterbored on the outside face of the disk. To do this a special head is to be put onto the cross-rail, having an index by which it may be set at any desired distance from the center, according to the stroke of the engine for which the disk is intended.

This head carries a conical casting or sleeve, in which is the boring bar, having a cutter at its lower extremity. At the upper end of this sleeve is a short cross slide, and for counterboring the hole the sleeve is made to revolve, carrying the bar and cutter with it, the cross-slide being used to feed the cutter outwards to form the counterbore. The boring bar does not lie in a line which coincides with the axis upon which the sleeve turns, but at a slight angle to it (though centered at the lower end), so that, as the sleeve revolves, the bar would be said to "wobble." The bar has an end motion through the sleeve, by means of a screw which is moved automatically, and it is evident that the further the end of the bar projects from the sleeve the greater the diameter of the circle which the end of the bar will describe in turning. From this the taper is derived for the hole. Of course during the boring of this hole the table of the machine does not revolve, but is locked in the proper position, the object being to do the work at one chucking and secure accuracy.

He was not Posted on Gas Engines.

In an alley off Fifth avenue there is a basement in which a gas engine is used. At certain times the gas engine emits a short, sharp explosion similar to a pistol shot. The other day a stubby, fat policeman was strolling leisurely through this alley and an idle printer was looking out of an upper window at a group of bootblacks tossing jackstones. The gas engine gave a particularly loud report. The fat policeman gained the end of the alley in a few rapid bounds. Then he peeped rapidly around the corner to see who had fired the shot. There was another sharp report. It startled the idle printer, and he drew back his head suddenly, breaking a pane of glass in the window. The fat policeman saw him, and he bounded up-stairs into the building.

"Why did you shoot at me?" he inquired breathlessly. The printer denied that he had fired a shot, and tried to explain, but the fat policeman emphatically declared that a bullet from the printer's revolver had crashed through the window pane and whistled dangerously near his head. It took four men half an hour to persuade the valorous officer that he had not been made a target of.—*Chicago Herald.*

LETTERS FROM PRACTICAL MEN.

That Road Carriage.

Editor American Machinist:

A. H. H. (Question 396) will need to speed his engines up to at least 300 revolutions; he might then, perhaps, get six or eight miles an hour on very good roads, but will require slower gear for climbing hills, and on heavy roads. It would be quite out of the question to couple direct to the axle.

B. Frank Mohr.

Valve Setting.

Editor American Machinist:

In the American Machinist of Sept. 1 is an article entitled, "Some Stray Kinks," in which instructions were given for setting an engine slide valve. It is therein asserted that the same principle will hold good for any valve motion of the slide type.

It can be shown that this rule is not comprehensive enough to cover all the ground claimed for it. To set the eccentric it is explicitly stated that the eccentric must be advanced ahead of the crank. Now where a rocker arm pivoted between the points of connection of eccentric rod and valve rod is used, the eccentric is behind the crank, instead of ahead of it.

Again, with a piston valve admitting steam at the center and exhausting at the ends, with direct connection to the eccentric—that is, without the rocker-arm—the eccentric will also be behind the crank.

The instructions for adjusting the length of the eccentric rod are very simple, and practically near enough correct. The following is offered as a more comprehensive and correct rule for setting the eccentric in correct position: Place the crank on a dead center, and turn the eccentric around on the shaft *in the direction the engine is to run*, until the valve opens the steam port at the end of cylinder where the piston is. Stop turning the eccentric when the port is opened the amount of lead wanted.

Applying the above rule to either case referred to, it will be found to give correct results, and it is believed that the rule is correct for any valve motion operated by an eccentric of fixed throw. If any reader can find an example where this rule is not applicable as above stated the writer will fully appreciate it if he will communicate the same to the American Machinist.

B. Crank.

Water vs. Dry Grinding—Grinding Reamers.

Editor American Machinist:

The use of water in grinding shafts in a grinding machine has more merit than it is generally supposed to have by many persons. Even manufacturers of grinding machines speak of grinding dry, and do not have the proper provisions for grinding with water. No shaft grinding can be done with accuracy and fine finish by dry grinding and the only objection, no doubt, that is found to water grinding is the inconvenience of its use (especially if the machine is not adapted for it) and the consequent slopping of water.

Grinding with water and plenty of it is what is necessary to produce first-class work, and with a grinding machine constructed to carry off all the water in a good manner there are no objections to its use; on the contrary, it avoids the disagreeable emery dust arising from dry grinding, which not only penetrates into the journals and wearing surfaces of the machine and adjoining machinery, but the lungs as well. This is one great advantage. The next is, it makes far smoother surfaces, and last, but not least, it makes the shaft nearer perfectly round and straight. I say "nearer," because absolute perfection is not attained in anything, but practically they get round and straight.

This fact was forcibly illustrated to me a few years ago, when starting a grinding machine which I constructed myself (which had ample provision for use of water). I started grinding a large shaft, which naturally was not perfectly true from the lathe. The emery wheel grinding on one side of the shaft heated that side, and expanded it, which forced the shaft against the wheel still harder, and heated it still more. By the time the wheel had run up to the end of the shaft and reversed, the heat became diffused or equalized in the shaft, and it assumed its normal position. Since the shaft was ground off severely on one side in the traverse just made, it now does its grinding on the opposite side of the shaft and starts up the same conditions in the reverse way. A continuance of this kind of procedure would never bring about a round or a straight shaft. This difficulty was experienced also with the use of water, but it was found that there was not sufficient water used. After running a good stream of water on the point where the grinding was being done, the shaft assumed its normal position, and being kept cool by it, the machine started making straight and round work, revealing at the same time what defective work dry grinding would make in this particular, that is, shafts at least of large sizes. And I believe the defect exists more or less in all work ground dry.

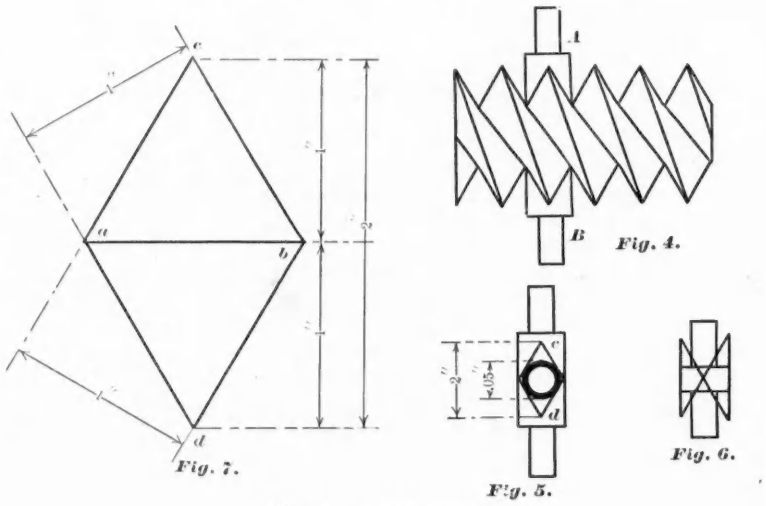
The disadvantage of a shaft being heated and expanded between centers necessitates the frequent adjustment of them, which, if not done, would be sufficient to spring a shaft out of truth regardless of the side heating spoken of, but with the use of water, once adjusting is sufficient to finish the shaft, excepting what wear there may be in this time in the centers.

Therefore I advocate water for grinding, and plenty of it, and a machine well adapted for its use, which cannot fail but give excellent results. A good emery wheel is also an important consideration.

From what Mr. Fay says in his article in the American Machinist of July 7, I conclude reamers are generally ground dry. I have tried that, and find it a risky operation, especially on reamers having a pretty thick tooth, as a slight drawing of the temper necessitates a re-tempering of the reamer. Dry grinding seems to be the general practice in grinding milling cutters, and with great care answers well, but with reamers where sizes must be taken care of, I think it is a wrong practice. By the use of water the expansion of cutting edges Mr. Fay speaks of would be entirely avoided the wheel cuts keener and is less liable to fill and glaze. In my estimation all grinding does better by the use of water, and when grinding machinery is not adapted for it, it should be made to be adapted. Reamers are far better when ground with the side of a wheel than with the periphery, thus avoiding the concave surface and consequent abrupt clearance at the very cutting edge spoken of by Mr. Fay. A large wheel used on the periphery of course is better than a small one, and the side of the wheel which makes a straight surface on the tooth better still. What I consider best of all is a convex surface on the tooth, with slight clearance from the cutting edge back. Reamers made in this way will hold their size longer than those made in any other way I know of.

I never ground any reamers in this way, but were I to do so I would use an emery ring that would encircle the whole reamer, of a diameter to give proper clearance by just escaping the tooth back of the one being ground. Index the reamer to correspond with the spacing of the teeth (which would be even and an even number), and use water freely.

A. B. Landis.



Measuring Screws.

Measuring Screws—Economy in Sizing Taps.

By Jarno.

SECOND PAPER.

To tap one hole in cast-iron will wipe three one-thousandths of an inch from the diameter of a sharp thread, says J. M. Carpenter. He adds: "It is hardly possible to keep anything like a really sharp thread tap. We should either not cut a tap to a full thread, or we should make the diameter of the tap larger than the standard. Then a screw that is to go into a tapped hole should be from three to five one-thousandths inch less diameter than the tap. If a tap be made sharp threaded it soon wears dull. It is better to have a new tap not quite sharp, or as near as may be to the shape it will soon come to in use.

"The same applies to a U. S. thread tap. It should be from three to five one-thousandths of an inch larger than the standard diameter, but the thread can be cut down to the same depth from the center of the tap as if the tap were of standard size. This leaves the flat part at the top of the thread a little narrower than one-eighth of the pitch. The U. S. thread screws that follow the tap can then be of the standard diameter. The object of making these allowances in the diameters of taps is to have the screws fit on the sides of their threads, and to avoid any tendency to have a thread bind at its outer part, or top."

I have no doubt but that Mr. Carpenter is right. By attending to his suggestions we can avoid the annoyance and loss from having screws wear loose, even while assembling a machine.

Of course, in sizing a U. S. thread tap at the sides of its thread the caliper will be set the same as if the tap blank were of standard diameter.

If a screw has an even number of threads, two threads, four threads, and so on, then a thread on one side of the screw is exactly opposite a thread on the other side. Such a screw cannot be measured in the same way as shown in the first paper.

Fig. 4 shows the principle by which a screw having an even number of threads can be measured. Each of the caliper nibs *A* and *B* has a groove through its face. These nibs, being held in the two caliper jaws, can be placed on any two opposite threads of a screw, as shown. The caliper should be adjusted so that it would read zero when the bottoms of the nib grooves *c* and *d*, Fig. 5, touched each other if this were possible. That is, the caliper would read zero when the nibs were in the imaginary position shown in Fig. 6. The caliper will then always read the actual distance between the bottoms *c* and *d* of the nib grooves, Fig. 5.

To adjust our caliper so that it will read in this way, let us first set the caliper to read, say, two-tenths of an inch. Now to make the nibs so that the distance from *c* to *d* shall be two-tenths of an inch, we will fit

them so that at four places they will just touch a round piece whose diameter is one-half the distance c to d, or one-tenth of an inch. The distance from c to d is now two-tenths of an inch, and our caliper is ready for work.

The reason for this may be understood from Fig. 7. The angles of an equal-sided triangle are each sixty degrees. When the nibs are near together, as in Fig. 5, the opening between the nibs is like the outline of Fig. 7. Fig. 7 is merely two equal-sided triangles put together. If the two triangles measure two inches from c to d, then the distance from either c or d to the line $a\ b$ is one inch, or one-half the distance c to d. Each triangle measures the same from any angle to the side opposite. Hence the distance from a to the line $c\ b$, or the distance from a to $b\ d$, is equal to one-half of the distance c to d. Then a circle of a diameter equal to half of the distance c to d will just touch the four sides of Fig. 7. For this figure the circle would be one inch diameter, because the distance c to d is two inches. Fig. 5 is a practical application of the foregoing principle.

In measuring a sharp double-thread screw with a caliper having nibs like Fig. 4, and adjusted as in the foregoing, the caliper reads directly the diameter of the screw by the sides of its thread. That is, we do not have to subtract anything from the diameter of the screw to know the caliper reading.

To know the caliper setting for a U. S. double-thread screw we must add to the diameter of the screw one-quarter of the depth of a sharp thread. The depth of a sharp thread, one to the inch, is .866″. One-quarter of .866″ is .2,165.″ Dividing .2,165″ by the number of threads to one inch, we have the amount to add to the diameter of the screw. The sum is the caliper setting. Let the diameter of the screw be D, the number of threads to an inch n, the caliper setting y, and the rule can take the form

$$y = D + \frac{.2{,}165''}{n}.$$

Example.—What is the caliper setting for U. S. thread screw 1″ diameter, 10 threads to 1″? One-tenth of .2,165″ is .0,216″, which, added to 1″, gives 1.022″ nearly, as our caliper setting. In machine shop practice, when a figure in the fourth place of a decimal is five or more it is customary to add one to the third place and omit the figure in the fourth place.

English Boiler Inspection.

By W. H. Booth.

ELEVENTH PAPER.

So far little has been said concerning the faults found by inspection to exist in furnace tubes. In examining a furnace the inspector gauges it at several points for both horizontal and vertical diameter, in order to ascertain its circularity or any departure from the truly circular form. This, if of appreciable amount, may be serious, as it would either show general flattening of the tube or a local distortion. If a general flattening existed it would be proof of the weakness of the tube unless of a constructional origin. Previous reports would be looked up if existent, to see whether an elliptical furnace was newly so or of old standing. In either case the fault is a bad one, and indicates either proceeding gradual failure or inherent weakness if constructional.

When local flattening exists it may be due to overheating, and overheating may be due either to shortness of water, an accumulation of scale, or to a possible overdose of some composition. Flat places are frequently forced back to arch form by a careful application of a screw or hydraulic jack within the furnace. When this is done the pressure of the base of the jack should be distributed well, and great care must be exercised to prevent over-stress being applied. Long furnace tubes, unstiffened by rings or flanged seams, are very weak and frequently collapse from end to end. The manner in which length of tube is unfavorable to strength appears to be thus: When the furnace crown begins to come down it must necessarily lengthen. In a long tube it can do this, because the whole length of the crown is there to provide the extra length, but when stiffening rings are introduced the two rings on either side of the collapsing portion of the tube serve as arches from which the collapsing weight hangs. The pulling-down tendency of the collapsing portion is changed by the arch of the ring into a direct horizontal pull along the crown of the tube, and hence, if at all affected thereby, it will be actually stiffened. Hence collapses do not run beyond the next stiffening ring, and a local collapse frequently goes no further than the formation of a pocket or two, the very formation of which may, by letting in water upon the heated plate, stop further collapse. No tube, therefore, however low may be the pressure to which it is exposed, should in any case be without stiffening rings above the furnace, at least as a safeguard against possible shortness of water. I have already described and illustrated the methods of applying such extra rings to old furnaces. New boilers of course are made with the flanged seam or other stiff joint ring. Of all seams the flanged seam is far and away the best, and though failures are known to occur it is chiefly from remediable causes. Though personally I have not met such a case, I have heard from inspectors who have known all the flanged seams in a boiler to fracture at the roots of the flanges in the lower semi-circumference of the tubes. Investigation has shown this to be due to suddenly cooling down the boiler with a water jet, perhaps when the flue tubes were half full of nearly red-hot dust. Needless to say, the practice is most harmful, and a boiler ought not to be emptied of water until such dust has been cooled off or removed.

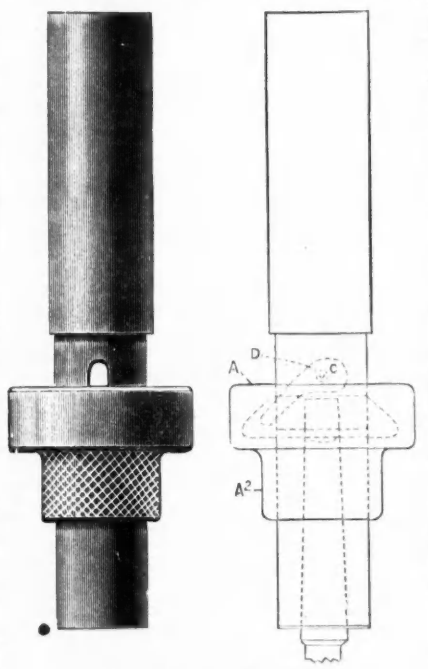
The price of good boiler plate is now so little above that of poor plate that it is questionable if any saving could now be effected by making a furnace crown of a good quality of plate, while the lower half of the tube was of inferior material. Such a course has been much followed in the past, when making flanged flues, Lowmoor or Bowling plates being used for the crown, and the lower halves being of cheaper material. Hence each ring of the tube would have two welds in it, in place of one. The use of steel has probably put a stop to such a practice, which is doubtless responsible for very many apparently mysterious failures of the flanged seam at the bottom, the inferior metal being unable to meet the demands made upon it by the difference of temperature between the crown and bottom, causing differential expansion and stresses. The writer is of the opinion that, with fair treatment, nothing yet brought out can equal the flanged seam in strength, durability, or true cheapness. It is a matter of common observation that furnace seams of the overlap type will almost invariably show signs of overheating when composed of two plates half an inch in joint thickness, that when made of $\frac{7}{16}$″ plate signs of heating are much less common, and when of $\frac{3}{8}$″ plate very rare. Now in the flanged seam there is only a single thickness of plate exposed to heat, so that a furnace with ordinary draught might be made of $\frac{1}{4}$″ plate and not burn.

In locomotive fire-boxes any plates of more than $\frac{3}{8}$″ thick burn away to $\frac{3}{8}$″ as a rule, but then the locomotive fire-box is badly designed to get rid of the steam bubbles from its surface, and the circulation of water is bad, the narrow water spaces being no doubt frequently filled with foam. In furnaces not made with the flanged seam the faults chiefly encountered, other than partial collapse, are chiefly fractures at the seams of rivets, and burning of the overlaps on the fire side, whilst on the water side corrosion from acid water is of course very common, the cure for which is simply the use of an alkali or some substance such as zinc, for which the acid present in the water has a greater affinity than for the iron or steel plate.

In iron boilers with steel furnaces, corrosion of the furnace is less severe as a rule than corrosion of the shell. This is at variance with the opinions of some engineers that steel is sooner corroded than iron. The writer's experience is contrary to this, however. In iron furnaces trouble is often caused by blisters or lamination of the plates. Though it is the heat of the fire which renders these apparent, they are really structural defects, and due of course to the presence of a stratum of dirt or cinder in the plate. Sometimes such layer runs out to the surface on both sides, and causes leakage; when this is not the case it is unnecessary to remove the plate containing the blister, unless this is of large area and upon a furnace not specially strong.

Usually it is sufficient simply to cut away the blistered portion, leaving the remaining thickness clean, but if of large area—we have cut them away over an area of two or three square feet—it may, as said above, be advisable to remove the plate entirely.

A point in regard to furnaces of some importance is the method of supporting fire-bars. It was once customary to support these by transverse bearer bars, which simply rested upon the furnace plates. This was very faulty, for the tendency was towards a wedging action of the bars upon the furnace under the great weight of fire-bars and fuel. The continually varying expansion and contraction due to varying states of the fire caused also considerable cutting



New Drill Socket.

action between the points in contact, and the furnace plates became cut and worn. Experience has therefore shown that the cross-bearers should be quite free from contact with the plates, and should simply rest freely upon bracket pieces, which must be securely fixed to the furnace. By this method there can be no wearing of the furnace plates, and the severe wedging action is avoided, so securing true circularity of the furnaces. To protect the crown of the furnace from the direct action of fire at its point of connection to the end plate, it is well to turn a short brick arch at this end, *i. e.*, above the dead plate. This also has its advantages in diminishing any tendency to the grooving of the connecting angle irons, to which reference has already been made in an earlier paper.

It is in view of the possible collapse of a furnace tube that the plates composing it should be of good quality, and ductile. When material of poor quality is employed, a very small depression of the crown of a furnace is often sufficient to tear the plate transversely, for it is then, of course, exposed to a tensile stress, and, having no elongation, can only lengthen by tearing. In the case of the experimental furnaces tested to redness by the Manchester Steam Users' Association, and cooled off by water when hot, there were formed deep pockets in the furnace crowns, probably six inches or more in depth, and yet no rupture had occurred. The danger of rupture is of course the conversion of the furnace into a steam gun with bricks, fire-bars, fuel and water as projectiles. If, however, a collapse occurs without rupture, no further damage is done, and in this respect steel has an immense advantage over iron, even of such qualities as Lowmoor.

The mere inspection of a boiler can tell nothing of the quality of plate from which it is made unless the brand is visible and the maker of the brand known for reliability. Hence it is largely the custom for steam users, when procuring new boilers, to have them inspected during construction, so that strict attention may be given to the quality of the plates employed, their ductility and strength. For furnaces it is customary to allow a higher tensile strength than for shells, as a stronger material better resists a stress of compression, just as in bridge work compression members are allowed up to a strength of 90,000 pounds, whilst tension members are not allowed beyond 74,000. Strength and stiffness, however, are not to be obtained at a sacrifice of the all-important quality of ductility, which is a *sine qua non* in good work, and 74,000 pounds is about an outside limit for furnace plates in English practice.

When furnace tubes are attached to the end plates by angle irons, these are, as already pointed out, very liable to groove, especially in the line of the root. A rolled angle iron is specially liable to this, owing to the run of the seams or faults in the direction of the rolling. It would be well if such attachments were made from specially bent angles, *i. e.*, bent from plates of homogeneous metal, free from striæ or possible stratification. In this way grooving could be eliminated to the greatest possible extent. Such rings would be easily made from cross-cut plates cut into strips of about six inches wide, welded into hoops and flanged in a press at one heat.

New Drill Socket.

The drill socket represented herewith is made by the Standard Tool Co., Cleveland, Ohio. It is made for holding taper shank drills, and does away with the use of key or drift for removing drills. As will be seen by reference to the outline cut, the device consists of a collar A and cam C, the latter being pivoted at D. To operate, the collar is grasped by the knurled part, and a sharp upward thrust given. This raises the cam C, and ejects the drill; it may be done, if desired, without stopping the drill press. The use of this device will, it is evident, save time in changing drills, as the machine may be left running and no time is lost in hunting up a drift and using it. It also prevents damage to the tongue or shank of the drill. The improvement can be applied to sockets now in use.

A Rare Example of Honesty.

The Pittsburgh *Dispatch* has the following in relation to a Wilkesbarre coal operator:

J. H. Swoyer, the well-known individual coal operator, died to-day, aged 78. Deceased had a remarkable career. He came here from Berks county in 1857, and at once entered into the coal business. He accumulated a fortune, but lost it all in the great miners' strike of 1877. Swoyer, in order to keep his mines from going to wreck, borrowed heavily of Bennett, Phelps & Co. When he had borrowed $200,000 he could not meet his notes. The bank was compelled to close its doors.

Many poor depositors lost all they had. Swoyer came out in aid, and said if God would spare his health he would pay every dollar back to the bank, and the depositors would lose nothing. Accordingly, after the strike ended, he went to work at once. He sold his horses and carriages and dismissed his servants. His palatial mansion was vacated, and Swoyer went to live in a small house in a back street. He also labored daily himself in the mines.

In five years he paid every dollar back to the bank, and the depositors got all their money back, with interest. When Swoyer made the last payment he said it was the proudest day of his life. The depositors in mass meeting eulogized him. Swoyer continued to prosper, and died worth $500,000.

A daily paper speaks of an engineer who "began firing on the Pacific Mail a number of years ago and then drifted into railroading." Just how long after he began firing he "drifted into railroading" is not stated,

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The Rhode Island News Company, Providence, R.I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
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The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y

NEW YORK, SEPTEMBER 29, 1888.

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Suburban Train Service.

The railroads of the country are doing good work in providing means for workmen and business men to reach their homes, situated within a radius of twenty-five miles of our large cities. But there is yet plenty of room for improvement in this respect. Some of the roads try to meet the case fairly well, although it is doubtful if the practice on any of them is as good here as in England. But there are others that do not rise to the occasion. In this they are shortsighted. In most of the villages near great cities there is a large population without any special ties to bind them there. They put the pleasant things connected with a residence in one village against those pertaining to a residence in some other, and are governed by this. And one of the most pleasant things is good train service, hence the road that gives this finds its suburban traffic increasing wonderfully.

Of course frequent train service is desirable, but less frequent, with, as near as practicable, absolute punctuality is better. Men will generally either hasten or delay their time of reaching a train by a few minutes without grumbling, if it starts promptly, and goes in a way that leads them to know they will get to their destination on time, and with reasonable dispatch. But nothing is quite so exasperating to the commuter as never to be sure just when his train will start, unless it is never to know when it will land him home or in the city.

Then again the commuter expects—or rather hopes—to travel in reasonably clean cars, which is something apparently never thought of on some roads.

The road that, other things being equal, gives the best service, at a reasonable price, will get the most suburban traffic, make the most money out of it, and the villages along its route will call it blessed. This is a matter that the railroad managers could profitably give more attention to than they do at present.

Threshing Engine Boiler Explosions.

The fact that the wheat crop of the country is now being threshed out and prepared for the market is vividly brought to mind by the numerous press dispatches coming from the West and announcing destructive and fatal explosions of threshing engine boilers.

Every machinist who has ever been around shops where threshing engines were sometimes brought in for repairs, is acquainted with the young countryman who calls himself the engineer, and who has not the least shadow of a doubt as to his ability to instruct the best man in the shop in the making, repairing and management of an engine.

He is usually one of three or four young men living in the same neighborhood, who, having grown tired of the daily routine of farm work, have combined their capital and purchased a threshing outfit, selecting in their wisdom the engine having the most red paint and the agent with the ablest jaw. None of them know anything at all about engines or their management, but are given a few lessons by the agent and assured that they can then manage the machine as well as any one, that nothing can happen anyway, everything has been provided for, so that an explosion is impossible.

Our young man who is chosen as engineer is likely to be somewhat afraid of the machine during the first week, but the second week he is confident that, with due diligence, he can manage to get along without blowing the thing up, and at the end of the third week he is certain he knows all that anyone else ever knew about running engines, and besides has discovered several points about the business that no one else ever knew. Then he soon arrives at the stage where he can put in a big fire, start the pump just right, and, seeking a shady place to rest, explain to the farmer's boy the intricate workings of a steam engine and the infinite importance of the man who runs one. From that time on the conditions necessary for an explosion are always present, and it is the merest good fortune if one does not occur.

Electric Motors.

An electric motor is in successful operation for wood-sawing in Lewiston, Me. It is a six horse-power, and with a 26-inch saw, which was driven at a velocity of 1,450 revolutions per minute, a cord of slabs was sawed in twenty minutes. The proprietor claims that with a six horse-power electric motor he can do more work than with a ten horse-power steam engine.

The foregoing, which we take from the *Engineering and Mining Journal*, contains one of the most common of fallacies, and this error seems to be not only thoroughly engrafted in the popular mind, but it influences those who ought to have sufficient mechanical education to know better. The electric motor is comparatively new, and there appears to be a popular delusion that there is a good deal of the miraculous connected with its operation. Any smart school-boy knows that a horse-power is just as definite a quantity as a pound avoirdupois, or a yard in length. And six or ten horse-power of work is the same, whether the last connecting link is an electric motor or a steam engine. But men otherwise level-headed get lost in the contemplation of something that has electricity connected with its operation.

It is not so very long since an electric motor was put on one of the elevated roads in New York. It was put on with a great flourish of trumpets, and was to do the work of one of the locomotives at present in use on these roads. The daily press interviewed the builder and prominent men connected with the enterprise, and—before the trial of the motor—worked up wonderful results in prospective. All the time, anyone with even a very elementary knowledge of tractive force knew, from the weight of the machine, as given, that it could not do the work claimed for it.

But on the predictions put forth, and the loose talk indulged in, great expectations were built up. It is hardly necessary to say that the trial proved a failure.

We are not arguing against the use of the electric motor. It will give out a part of the power put into it, just as any other connecting link will do. But it would be well for those who are interested in electric motors to apply a little common sense to the problems of the case. Cause and effect will always be found to balance, one the other.

Let those who are carried away, as it were, by the possibilities of electricity, ground themselves on the fundamental principles of mechanics, and they will not be likely to be led astray by the loose talk indulged in by those who are puffing electric motors. In mechanics it is well understood that it is not possible to get something from nothing. This holds true, whether the connection between the power and the work is made by electricity or otherwise.

There is considerable complaint by the makers of tool steel in regard to the way their product is handled by tool makers. The extensive use of costly and complicated shapes of cutting tools, even in the ordinary machine shop practice of the present day, and the increased use of such tools for cutting steel instead of iron, leads to a demand for steel of high temper. But the steel makers say—and truly—that such steel must be worked with great care, or satisfactory results will not obtain. Greater care must be used than in working steel with less carbon. Such steel is bought with the expectation of getting superior results, and if they are not obtained the steel maker is blamed when the fault may be entirely in the way it is worked. Shallow fires, and uneven heating and overheating, lead to a good deal of fault-finding with the higher grades of tool steel. It requires skill of a high order, and much care and judgment, to manage in the forging and tempering these high grades of steel, and unless this is employed it is quite as well, or better, to use steel lower in carbon, which will stand rough treatment better than the higher grades. And there is a demand for men who can successfully work tool steel of the kind that steel makers will furnish for the better and more costly class of tools.

We have frequent inquiries, from all parts of the United States, as to the location of schools where mechanical engineering, drawing, etc., is taught. If the representatives of such schools will take the pains to send us their addresses and titles, not presuming that we are already familiar with them, we will publish them for the good of all concerned.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(424) W. R., ——, asks: What steps shall I take to secure a patent? *A.*—Apply to a patent attorney.

(425) G. A. K., Barton, Vt., asks: Do you think it would be practicable to run gears 8 inch diameter, 1½ face, 12 diametral pitch, at a speed of 5,000 turns per minute? They are to be in a train, four of them; the first one will have to transmit about two horse-power, the others less. *A.*—We do not think it will be practicable or safe to run gears of that size, made of any ordinary material, at such a speed.

(426) J. W. K., Greensburg, Pa., writes: I wish to get information upon the subject of making solid pipe dies for power, from 3 to 7 inches diameter. How to make the recesses or spaces to form the cutting edges, and how to temper the die. *A.*—This is one of those questions which we cannot very well answer, because a complete answer to it would be quite lengthy, and would contain nothing except what is already familiar. Besides, it would scarcely benefit any one, because any good mechanic who ever saw a solid pipe die would be able to make one, and any one not mechanic enough to do so would hardly be enabled to do it by anything which we could write. All we could say is, prepare the block the proper size, and either tap or chase it to the proper size in a lathe having a taper attachment. Lay off the cutting edges, making them radial, and also lay off the space to be cut out; remove the metal by drilling, chipping and filling. The tempering it would be useless to describe; it can only be done satisfactorily by a person skilled in tempering.

(427) M. J. G., Cincinnati, Ohio, asks: Please give me a simple rule for determining the angular advance of an eccentric, also a rule for determining the travel of the valve. *A.*—The amount of angular advance depends upon the design of the engine; and the same may be said of the travel of the valve. When there are direct connections between the eccentric and the valve, as shown in Fig. 30, AMERICAN MACHINIST, Sept. 26, 1885, or in other words, when no rockers or intervening levers are used, the angular advance of the eccentric is determined in the following manner: Describe a circle with a radius equal to the eccentricity of the eccentric, that is, the distance from the center of the shaft to the center of the eccentric wheel. Through the center of this circle draw a straight line, and on the circumference of this circle lay off a point; the perpendicular distance between this point and the straight line (drawn through the center of the circle) must be equal to the lap and lead of the valve. Through this point and the center of the circle draw a straight line; the angle formed by this line and the line through the center of the circle will be the angular advance of the eccentric. Whether or not the line through the center of the circle shall be perpendicular to the center line of the crank depends on the design of the engine. When rockers are used the angular advance of the eccentric will not only depend on the lap and lead, but also on the difference of the lengths of the rocker arms. You will find the method for determining the angular advance of an eccentric explained in detail and illustrated in the AMERICAN MACHINIST, Oct. 24, 1885, page 1. In the same paper is also given a practical example on determining the position of the eccentric relative to that of the crank for a certain class of engines. In our issue of Sept. 4, 1886, page 4, we have shown the effect produced on the travel of the valve by the difference of the lengths of the rocker arms. In the issue of Dec. 25, 1886, page 4, you will find a practical way of setting the eccentric, and a practical method given for finding the angular advance. In the issue of April 2, 1887, page 7, we have shown the method for finding the angular advance of eccentrics in engines in which rockers are used; and lastly, in our issue of April 16, 1887, page 5, you will find the method for determining the relative position of the eccentric to that of the crank in the latter class of engines. The travel of the valve is equal to the throw of the eccentric, that is to say, equal to twice the eccentricity of the eccentric, when there is a direct connection between the valve and the eccentric. In other cases the travel of the valve will have to be determined by rules given in the papers referred to.

(428) E. W., Toronto, Ont., asks: In calculating the speed of an emery wheel, should its speed be less if the work revolves, than if the work be stationary? *A.*—No: the speed of an emery wheel should at all times be as high as it is safe to run it, and the faster it can be run the better it will work. The fact of the work running will give a little greater relative surface speed, but that is advantageous, so far as it goes.

(429) C. W., Cedar Rapids, Iowa, asks: Can you or any of your readers give me a simple device for turning the taper shanks of twist drills in a lathe without taper attachment? I use a solid center with the end drilled out a little, and drive with a dog; it breaks the edge of the drill when the tail stock is set over. *A.*—We know of nothing more simple than the taper attachment for this purpose, unless it be a compound rest; but the latter would need an automatic feed to be effective when much of such work is to be done.

(430) R. J. D., Ottawa, Ont., sends a diagram of pulleys connected by a quarter twist belt, and wishes the exact lines for placing the pulleys for such conditions. He will find such a diagram in the article by Frank H. Richards, in our issue of Sept. 8. We can see nothing wrong with the diagram which you send, but cannot see why any tightener need be used. Where one of the shafts is vertical it may be necessary to move the pulley on this shaft a little, to counteract the tendency of the weight of the belt to run it off.

(431) K., Philadelphia, asks: Will you please inform me how the finish upon decorative iron work used on lamps, screens, etc., is produced? *A.*—We do not know what particular kind of finish you refer to: there are several kinds; but it is done by electro-plating in some cases, in others by dipping in solutions of various kinds, the nature of the solution depending upon the kind of finish it is desired to produce. Iron castings may be bronzed by first thoroughly cleaning them, and then immersing in a solution of sulphate of copper; they are then washed in water.

(432) F. B., Quincy, Mass., writes: I have the plan of a machine for adding up figures. Will you please inform me if there is at present a machine for that work which gives satisfaction, and if there is any demand for such a machine? *A.*—Machines for such work have been devised, but we do not think they have been very successful, simply because men who have sufficient adding to do to make it worth their while to purchase such a machine soon become by practice so accurate and quick at adding that they need no machine. Still, of course, it is possible that a machine may be invented which will become popular, but it must be very simple, convenient to use, and very rapid.

(433) A. B. D., Fitchburg, Mass., asks: What particular course of study would you recommend to a young man learning his trade and wishing to become a good machinist? If he could afford to follow only one course, for the present, which course will be preferable? *A.*—If circumstances will permit you to pursue only one course of study, then we should strongly advise you to study practical drawing, often called mechanical drawing. In all first-class machine shops it is the custom to work to drawings, and without a knowledge of this subject we cannot perceive how you or any one else can become a first-class machinist. But in the meantime we cannot see what is to prevent you from studying useful and important branches of mathematics. Procure, for instance, a good arithmetic, and a good elementary geometry. The price of these books is small, probably will not exceed $1.25 each, and the subjects on which they treat are easily mastered without a teacher. Why not take up these studies at the same time that you commence mechanical drawing? A knowledge of arithmetic and geometry will enable you to solve many important problems relating to machinery, such as ascertaining the cubic contents and weights of different parts of machinery, speeds of pulleys, and many other kindred problems.

(434) J. O., Brainerd, Minn., writes: I intend to build a common road cart, strong enough to carry two persons. I intend to use three wheels two in the rear and one in front. The rear wheels to be 5 feet in diameter, to be driven by steam. The front wheel is to be used for steering. Want to burn coal or oil, boiler to be behind the wheels. The wheels are to make 24 revolutions per minute. The roads are a little sandy. Please give me the size of boiler, thickness of sheil, number of flues, size of cylinder, ports, valves, pumps or injectors; size of fly wheel if one is needed; size of gear wheels if any are required, and other necessary data. *A.*—The dimensions you ask for cannot be correctly obtained without making a complete drawing of the machine, so that the total weight of the machine can be calculated, and boilers and engine proportioned to suit. It is also necessary to know more of the character of the roads on which you desire to run. If we had drawings on hand for such a machine we should be glad to give you complete specifications. Under the existing circumstances we can only advise you to engage a first-class experienced draftsman to design the machine and make the necessary calculations. Without such assistance you will incur an unnecessary expense, and probably meet with failure and disappointment in the end.

(435) W. T., Philadelphia, sends a sketch of a screw 2½ inches diameter, ½ inch pitch, having keyed to its upper end a gear 18" pitch diameter, the collar for taking the end thrust of the screw being on the under side of the gear. A nut is fitted to the gear and prevented from turning, to which is attached the weight, 50,000 pounds, which is to be raised one inch per minute. He asks: 1. How can I calculate the friction in such an arrangement, so as to know how much power to apply to do the work? *A.*—The amount of friction in such an arrangement cannot be calculated with certainty, but in providing power to move such a screw, we should make allowance for 70 or 75 per cent. of friction. 2. What is a simple way for me to calculate the size and face of gear teeth strong enough to drive it? *A.*—If the face width of the gear equals twice the circular pitch (which it should nearly), multiply the square root of the total force to be transmitted by .035 if there is little or no shock, .05 for moderate shock, or .055 for violent shock. The authority for this is Cromwell's Treatise on Tooth Gearing. According to this, if the strain to be transmitted by the teeth of this gear be 1,000 pounds, without shock the circular or chordal pitch should be about 1 inch, provided the gear be of cast iron, which we suppose it to be.

(436) R. V. H., Chicago, Ill., writes: Please give me the rule for ascertaining the capacity of a ladle for molten iron. *A.*—First find the cubic contents of the ladle. When the ladle is of circular form, that is, when the upper inside diameter and the lower inside diameter of the ladle are equal to each other, then multiply the area in square inches of the bottom of the ladle by the height in inches; the product will be the contents in cubic inches, thus: It is required to find the cubic contents of a ladle whose inside diameter is 24 inches; height, 27 inches. The area of 24 inches is equal to 452.39 square inches; hence $452.39 \times 27 = 12214.53$ cubic inches, which is the cubic contents of the ladle. If the inside of the ladle is tapered, that is to say, when its upper inside diameter is greater than the lower inside diameter, the cubic contents are found by the following rule: Add together the square of each diameter, and the product of the diameters; multiply this sum by .7854, and by one-third of the height; thus: It is required to find the cubic contents of a ladle whose upper inside diameter is 24 inches; the lower inside diameter, 20 inches; height, 27 inches. The square of the upper diameter is equal to $24 \times 24 = 576$; the square of the lower diameter is equal to $20 \times 20 = 400$; and the product of the two diameters is equal to $24 \times 20 = 480$; the sum of these three products is equal to $576 + 400 + 480 = 1456$; multiplying this sum by .7854, we have $1456 \times .7854 = 1143.54+$; and lastly, multiplying this product by one-third of the height, we have $1143.54 \times 9 = 10291.86$ cubic inches, which is the cubic contents of the ladle. If we now wish to find the weight of the metal which the ladle contains, we simply multiply the number of cubic inches just found by the weight of one cubic inch of metal; the product will be the total weight. If, for instance the ladle in the first example contains cast-iron, and assuming the weight of one cubic inch of cast-iron to be equal to .26 of a pound, then the total weight of iron in the ladle will be $12214.53 \times .26 = 3175.77+$ pounds.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

See Grant's Gear advt. on back page.

Link-Belting.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Machinery Co., Chicago and N Y.

See our new designed engine lathes in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed drill presses in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed shapers in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed brass working too's in Cincinnati Centennial Exposition, Lodge, Davis & Co.

2,000 feet of space in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See special adv't, page 16, Lodge, Davis & Co.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee Falls, Mass.

Machine work and pattern making. Anderson Machine Works, Peekskill, N. Y.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co. Moline, Ill.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor Fulton and Dutch sts., New York.

"Swift" Sight feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Davis Key-Seating Machines, kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 120 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Drawings, mach. patterns and models. Inventors' ideas perfected. Valentine, 15 Alling st., Newark, N.J.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Brown & Sharpe Mfg. Co. have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Pattern letters and figures to place on patterns for castings. H. W. Knight & Son, Seneca Falls, N. Y.

Mechanical drawing, calculations, etc., taught by correspondence. I. Donald Boyer, Dayton, Ohio.

Patents—Whittlesey & Wright, 705 8th st., N. W., Washington, D.C. Send for pamphlet and references.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 West 13th st., New York.

If you visit the Ohio Centennial at Cincinnati, see the Waterhouse Arc Light Plant. W. N. Gray, agent, 56 Longworth st., Cincinnati, Ohio.

Patent Attorney. R. G. DuBois, 916 F. st., Washington, D. C. Service at reasonable rates. Send for pamphlet containing list of references.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Machinists supplies, brass goods, m'f'rs supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N Y.

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.

Curtis Pressure Regulators. Curtis Return Trap, Curtis Damper Regulator. See Sept. 1, p. 12. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

Upright drills, improved, sizes 21", 23", 25", 28", 32", 36" swing; finely made and great capacity; write for cuts and prices. Currier & Snyder, Worcester, Mass.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing gray iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N.Y.

A system of easy lettering by J. H. Cromwell, giving 26 forms of alphabets. The space to be lettered being divided into squares; simple and effective. Price 50 cents. Calalogue of books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including Sept. 22, 1888 issue, 59 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton st., New York.

"Modern Locomotive Construction," By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 73 articles have thus far appeared up to and including the Sept. 15, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton st., New York.

MANUFACTURES.

B. King will build a large foundry and factory at Chicago, Ill.

It is said that a big iron plant is to be built at Mifford, Utah.

The Central Iron Works, St. Louis, Mo., has been running day and night for some time.

The Newman Paper Co. are building a new mill at Kokomo, Indiana.

The Decatur (Ala.) Electric Light and Power Company will enlarge their plant.

C. Philpot will build a planing mill and a sash, door and blind factory at Cedartown, Ga.

The Farrel Foundry and Machine Company, Ansonia, Conn., are building a foundry 100 x 250 feet.

Sales of the Babcock & Wilcox boiler for the months of July and August aggregate 15,162 horsepower.

The Lidback M'f'g Co., Portland, Maine, are putting in new tools for making the Lidback high speed engine.

A stock company has been formed to manufacture artistic furniture at West Paris, Maine. Geo. S. Hunt is president.

Arthur M. Williams has purchased a building at Hubbardston, Mass., and will put in machinery for manufacturing cassimeres.

The Milvale Construction Company has been organized at Millvale borough, near Pittsburgh, Pa., where works will be erected for the building of fire escapes, shutters, etc.

It is said that Lister & Co., of Bradford, England, very extensive silk manufacturers, have purchased land at Black Rock, near Buffalo, N. Y., and will put up works to employ 600 hands.

Enlargement of the locomotive works at Rome, N. Y., is now going on. An addition is to be made to the blacksmith shop, 65 x 75 feet; a paint shop 60 x 160 feet will be built, and probably a boiler shop 100 x 250 feet.

The Samson Cordage Works, of Boston, Mass., succeeds J. P. Tolman & Co. They make bell cordage for cars, and other specialties.

Chas. R. Vincent & Co., 15 Cortlandt st., New York, send us an illustrated catalogue of engines built by the Ball Engine Company. The catalogue is neatly gotten up, and in addition to description of engines, contains other valuable information.

The city of St. Joseph, Kan. has secured a contract for the removal of Omaha Nail Mills to that city in consideration of a cash bonus of $50,000, and four blocks of ground. The negotiations for this removal of an important plant to St. Joseph were made through the Manufacturers' Bureau of that city.

The Binghamton Hydraulic Power Company, of Binghamton, N. Y., have acquired the sole right to manufacture the Richards oil engine, heretofore built by the Adams & Richards Machine Co., of New Brunswick, N. J., and having also bought the plant of the latter company are putting the engine on the general market.

The Cooke Locomotive and Machine Company, Paterson, N. J., are building new works in the same city. This fall they will erect the machine shop 500 x 120 feet; erection shop, 150 x 90 feet; blacksmith shop, 180 x 60 feet; hammer shop, 160 x 60 feet, and boiler house and stack. The foundry and boiler shop will be erected next spring.

The Hill Brothers, of Canaan, have offered to build and operate a factory at Mainstream, in Harmony, Maine, at a cost of $50,000, if other parties will loan them $10,000 after the completion of said building, with a first mortgage on the same, payable in five years at six per cent. interest; the mill to be operated for the manufacture of woodenware.

A press dispatch from Jefferson, Tex., says: Much excitement prevails here over Jefferson's prospects for having two large iron furnaces erected by the Chicago syndicate, who have been here for some time looking after the iron ore of the county. They have made a proposition which is likely to be accepted, and will guarantee work to be started soon.

The Randolph Shafting Trust, 280 Broadway, New York, is the name of a company formed, not to stifle competition or limit production, but to manufacture and put on the market a line of self-lubricating graphite journal bearings, for shafting and car purposes. Their works are now located at 69 Frankfort street, this city. They expect to considerably increase their manufacturing facilities in the near future.

Chas. A. Schieren & Co., New York, have recently been granted a patent for preventing air cushions in belts run at high speed. The plan is to perforate the belt regularly, so as to preserve uniform strength. It is said that these perforations not only prevent air cushions, but also prevent noise, and that the perforated belts run steadier than those not perforated. These perforated belts are particularly recommended for dynamos.

The Daily Hot Blast says: Although everything at the Barbour Machine Company's works [Anniston, Ala.] is not yet in successful operation, they have just completed and will ship to-day the first cotton gins ever manufactured in Anniston. They are beauties, complete with feeders and condensers, and find a ready sale. The Barbour gin, in South Alabama, bears an excellent reputation and has been widely sold. The trade throughout this section will be extensive in a few years.

The May Wind-Mill factory at Galesburg, Ill., is about ready for starting. A Galesburg paper says: "The factory is very conveniently arranged with a special view and adaptation to wind-mill manufacturing, being the only factory in the State that we know of which is specially built and arranged for making wind mills and brass cylinder pumps. We saw several machines which the May Brothers themselves have invented, adapted to this purpose only. Tanks and towers will also be made."

The syndicate of creditors who bought the Pittsburgh plants of Graff, Bennett & Co. will blow in Clinton Furnace in about two weeks. They will soon afterward start the rolling mill on the South Side (Clinton), and they will also likely start the Millvale mill before winter sets in. The Grafton furnaces, at Leetonia, Ohio, formerly owned by Graff, Bennett & Co., have been leased by W. D. McKeefrey, of Sharon, Pa., and will be put in blast this week. The annual capacity of the two furnaces is 20,000 tons each.—*American Manufacturer.*

The Chicago *Tribune* says: It seems likely that the enormous demand for structural steel will soon lead to the construction of works near this city for its manufacture, in addition to those now being developed by the North Chicago Rolling Mills. There is an organization now in existence called the Calumet & Chicago Rolling Mill Company, which proposes to erect a plant somewhere along the Belt Line, equip it with the modern machinery for the manufacture of structural steel, and compete with the Carnegie Trust. The capital stock of the company is $500,000, and it is supposed that the proprietors of the Ætna Iron and Steel Works are among the subscribers. The location is not yet decided upon, but the plans for the building and machinery have been drawn. There will be one structure 225 x 216 feet and six smaller ones. It is claimed that the product can be turned out in Chicago at lower cost than in Pittsburgh. The equipment will be of the heaviest. The North Chicago Rolling Mills have been using 21-inch rolls, but it is found that they are not large enough, and the new company will use rolls from 25 to 33 inches in diameter. The steel will be made on the premises.

P. M. Sharples, Westchester, Pa., is going to build a new machine shop with foundry attached.

The works of the Oregon Iron and Steel Company, at Oswego, Oregon, are about ready for operations. It is expected that the company will build rolling mills.

J. W. Penney & Sons, Mechanics' Falls, Maine, make steam engines and general machinery. They have been busy all summer working on orders. This firm is a progressive one and is building up a fine business.

Machinists' Supplies and Iron.

NEW YORK, Sept. 13, 1888.

Iron—American Pig—There is no new feature in the general condition of trade, and the market has ruled quiet and steady. There is a more confident feeling regarding the future, but large consumers seem little inclined to increase their stocks. The demand for standard brands of both Foundry and Forge has been fair. Deliveries are better than during July and August, but not equal to the demand at this time last year. We quote Standard Lehigh and North River brands $17.50 to $18.50 for No. 1 X Foundry; $16.50 to $17 for No. 2, and $15 to $16 for Grey Forge.

Scotch Pig—Higher quotations in Glasgow, combined with an advance in ocean freight rates, have caused an increase in prices here, and this has restricted sales, so that the market rules dull. We quote Coltness, $21 to $22; Gartsherrie, $19.75 to $20; Summerlee, $21 to $21.50; Eglinton, $19 to $19.25; Dalmellington, $20.25 to $20.50, and Clyde, $20.25 to $20.50.

Copper—Prices in London continue to rise, and the indications here are that the syndicate has complete sway. Quotations are 17c. to 17¼c.

Tin—Speculative influences seem to control the market, and the tendency is to advance prices. Jobbing lots Banca are quoted at 23¾c.; Straits and Malacca, 23¾c.; Biliton, 23¼c; Australian, 23¼c.

Antimony—Regulus is in fair demand, jobbing at 9¾c. for Hallett's and 13c. for Cookson's.

Spelter—The market rules quiet, and supplies are held at 4.85c. to 4.90c. for prime brands. We quote ordinary brands of Western 4.75c. to 5c.; Choice, 5¼c.; Refined, 6¼c. to 7¼c., and Silesian, 5½c. to 5¾c.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to examine S. S. planes; see p. 11.

Mech'l draftsman and designer, has had practical shop exp., wants position. Box 20, AM. MACHINIST.

Mechanical draftsman, with practical shop experience, wants position. BOX 23, AMERICAN MACHINIST.

Wanted—At 151 Cedar st., New York, two or three skillful general mechanics; none others need apply.

Wanted—A first-class pattern maker; permanent position. Address Gaysport Foundry, Hollidaysburg, Pa.

Wanted—Travelers for New England and Middle States, to handle mechanical goods; liberal commission. BOX 17, AMERICAN MACHINIST.

Wanted—Situation by machinist as salesman or charge of shop; experienced on experimental and general machinery; refs. C. B., AM. MACHINIST.

Wanted—Position by man with 10 years' experience on motive power accounts, last part as chief clerk; best references. Box 24, AM. MACHINIST.

Wanted—Position as draftsman by young man 28, graduate of technical school; six years' shop experience on various classes of work, and six years' as draftsman on tools and general machinery. Address G. N., AMERICAN MACHINIST.

Man of thorough practical as well as theoretical training, wishes situation as superintendent in a good concern, where he can obtain in time interest in the business. Address Superintendent, care AMERICAN MACHINIST.

A1 draftsman and designer, capable of superintending works, desires engagement; has had 15 years' practical experience in designing and inventing special and labor-saving machinery; 8 years with last employers; excellent references. A. C. Campbell, care AMERICAN MACHINIST.

Wanted foundry foreman. A thoroughly reliable man who is capable of producing first-class work at minimum cost, in pulley and machine castings, heavy and light, can find steady employment at the highest wages with us; must produce proper and reliable recommendations, which will be thoroughly investigated. Todd Pulley & Shafting Works, East St. Louis, Ill.

Wanted—An experienced foundryman as assistant to superintendent of large foundry in the West, making heavy machinery castings in connection with a large manufacturing establishment; must have full knowledge of mixing various irons and moulding of heavy general castings. Applicant should give references and general history of applicant's experience. Address Box 21, AM. MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Gerlach's Engineers' specialties beat the world. Send for price list. Crescent Mfg. Co., Cleveland, O.

Crescent grease cup for shafting beats them all Sample free. Crescent Mfg. Co., Cleveland, Ohio.

August C. Christensen, 24 State st., N. Y., mechanical engineer and draftsman; 25 years' experience.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

D. J. Kelsey, M. E., designs machinery and iron structures; pat. drawings. 31 Ins. Bld., New Haven, Ct.

For Sale—One each, 1⅛", 2⅛" Merriman bolt cutters, new and complete. The McLagon Foundry Co., New Haven, Ct.

Correspondence solicited with parties having machine or foundry specialties to build. Honesdale Iron Works, Honesdale, Pa.

An energetic young man, practical machinist and draftsman, would buy half interest in paying machine shop or foundry. Partner, AM. MACHINIST.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Hardware, light machinery and models in brass, iron or steel made to order in small or large quantities. Catalogue of model supplies and tools free. Goodnow & Wightman, Boston, Mass.

Ernest W. Naylor, consulting engineer, 149 Broadway, N. Y. Designer of the heaviest class of machinery used in the manufacture of iron and steel; hydraulic forging presses, etc.; armor plate presses, cranes and hoists of every description, and up to any size.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

ESTABLISHED 1832

Combines the best elements essential in a first-class **Hammer.** Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the world.

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With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements. **For hard coal or coke.** Indispensable in all shops to keep **Bradley's Cushioned Hammers** and men fully employed and reduces cost of production.

Pat. Aug. 30, 1887.

BRADLEY & CO.
SYRACUSE, N. Y.

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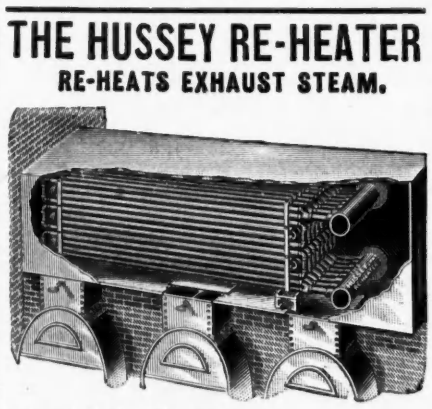
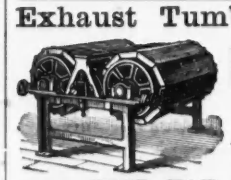
RE-HEATS EXHAUST STEAM.



Super-Heats Live Steam,
Heats Air or Water
WITHOUT COST.
The Hussey Re-Heater and Steam Plant,
IMPROVEMENT CO.
A. S. HATCH, President.
S. D. BREWER, Gen'l Manager. 15 Cortlandt St., N. Y.

FOR SALE. CORLISS ENGINES.
The Fishkill Landing Machine Co., located at Fishkill, on the Hudson, N. Y., offer to manufacturers and others desiring a well built, economical and durable engine, their improved CORLISS ENGINES. They are endorsed by many reputable engineers and persons using them. Address as above.

Exhaust Tumbling Barrels.



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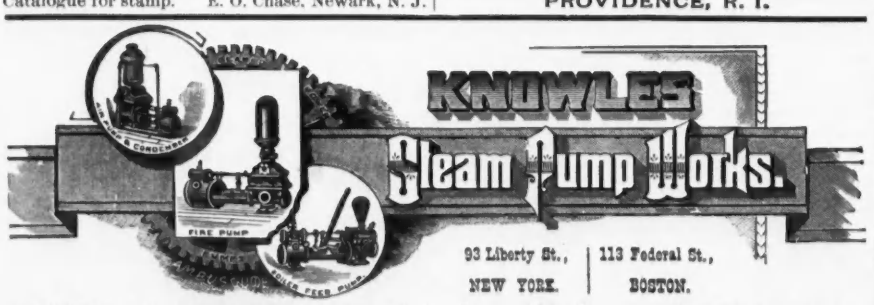
Friction Pulleys, Clutches and Elevators.
PROVIDENCE, R. I.



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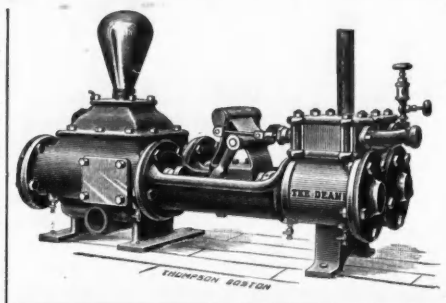

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New York, Boston, Chicago, Philadelphia
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STEAM and POWER
PUMPS
FOR ALL PURPOSES.
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THE HENDEY 18-INCH ENGINE LATHE
Combines modern design with superior workmanship at a moderate price. No extra charge for Compound Rest, Hollow Spindle or Power Cross Feed. Length of beds, 6, 8, 10, 12, 14 and 16 feet. Have other sizes of Lathes; also, Shapers, Planers, &c. Send for Catalogue and Prices.
THE HENDEY MACHINE CO.,
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DON'T Forget to specify the purpose for which steel ordered is to be used. You have no idea how much more likely you are to get just what you want by doing this.
SEND FOR CIRCULAR CONTAINING INFORMATION ABOUT STEEL TO
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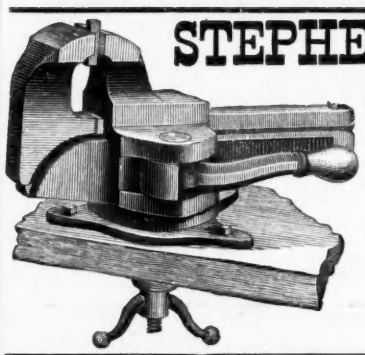
64 & 66 SO. CLINTON STREET, CHICAGO, ILLS. CRESCENT STEEL WORKS, PITTSBURGH, PA. 480 PEARL STREET, NEW YORK, N. Y.

Sebastian, May & Co.'s Improved Screw Cutting FOOT AND POWER LATHES

Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
167 West Second Street, CINCINNATI, O.
OUR SPECIALTIES, 8, 12, 14 and 18 inch Lathes.

STEPHENS' PATENT VISES.



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INCOMPARABLE FOR STRENGTH, DURABILITY, FIRM HOLD AND QUICK WORK.
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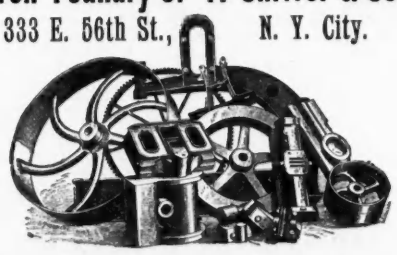

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A simple device used to fill under clamps, when clamping work to various machines. Does away with lumber yards, scrap piles and confusion about your shops. Send for descriptive circulars and prices.
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"Star" Foot Lathe Swings 9x25 in. | LATHE | Screw Cutting Automatic Cross Feed, etc.
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FOR SAW MILLS, FOUNDRIES AND MACHINE SHOPS
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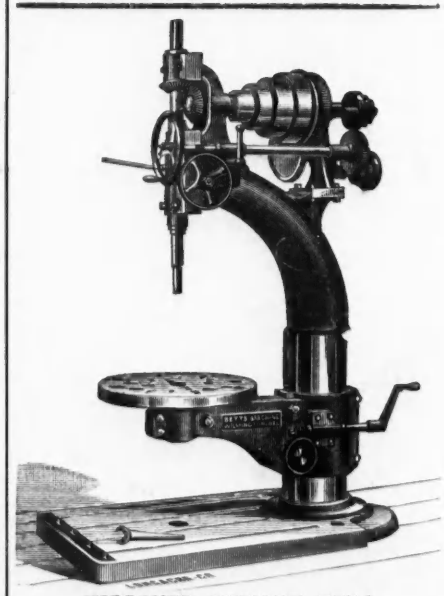
Independence Wood Split Pulleys.
COOKE & CO., No. 22 Cortlandt St., NEW YORK.,
Carry a stock equivalent to over 40,000 iron pulleys, lighter and better than iron.
Read the following extract from a letter from one of our customers, referring to these pulleys.
"P. M. BARROW,
"Tanner, Currier and Dealer in all kinds of Rough and Finished Leather.
"Ringtown, Pa., July 19th, 1888.
"COOKE & CO.,
"Gents:—* * * * * * * * They are the best pulleys I ever saw; our stone ran so fast that the grain could not get down, but would fill up the eye in the stone and when full would drop in a quart or two at a time and slip the strap on the line shaft, and threw it off several times. But there was no slip to this. I told my son we would never buy an iron pulley again.
"Yours truly, "P. M. BARROW."
Write for Prices, Mentioning this Paper.

PATENTS THOMAS P. SIMPSON, Washington, D. C. No atty's fee until Patent obtained. Write for Inventor's Guide.



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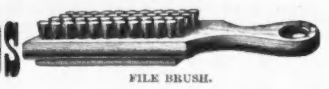
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Having the Increment Cut.

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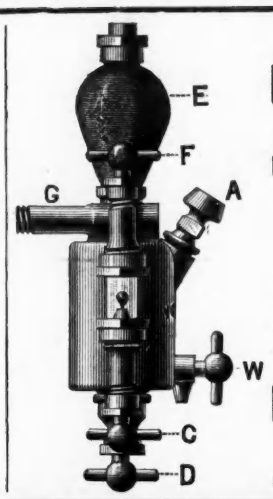

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Price.....	$10.00	$12.00	$15.00
Capacity....	⅓ pt.	½ pt.	¾ pt.

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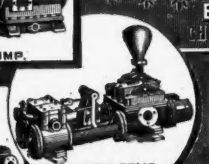
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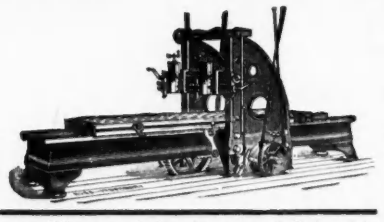

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Slow-speeded, Force-blast. Durable, Compact and Cheap.
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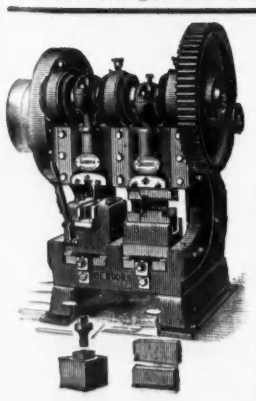

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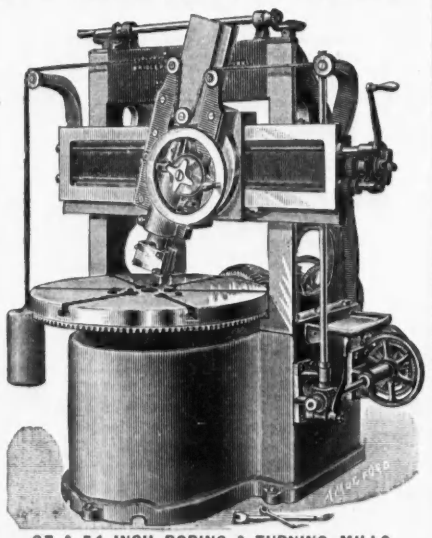

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Amateur's Size.

Taking anything from ⅛ to 1 inch inclusive.

Price,.....$5.00

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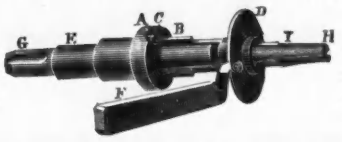

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No.	Price.
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3.....1½ " 2	" 18
4 (with screws) 2 " 3	" 32
5 " " 3 " 4	" 44

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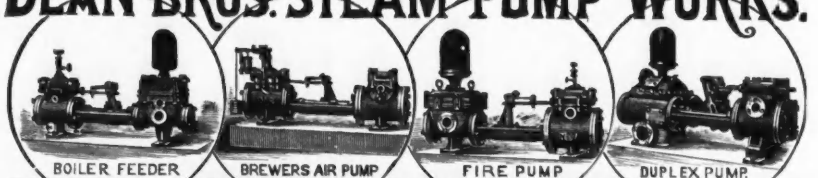

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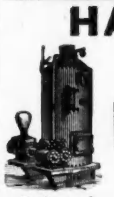
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Fire Pump.

GUILD & GARRISON,
Kent Ave. and South 10th St., Brooklyn, N.Y.

Builders of Steam Pumps, Vacuum Pumps, Vacuum Apparatus, Filter-press Pumps, Air Compressors, etc.

THE LAIDLAW & DUNN CO.,
CINCINNATI, O.
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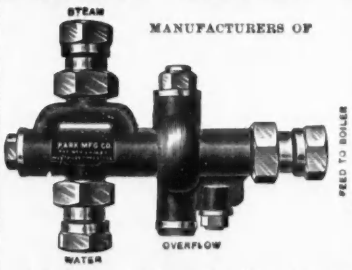

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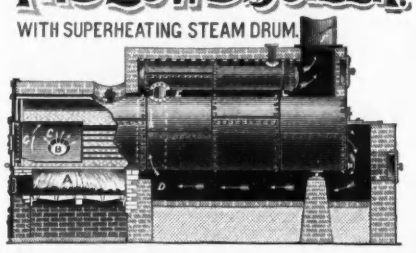

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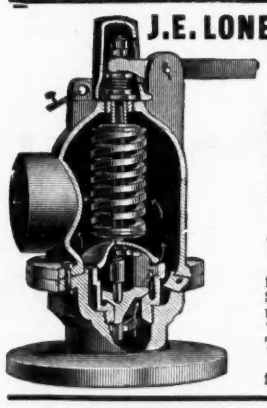

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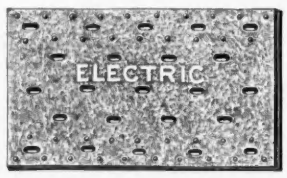

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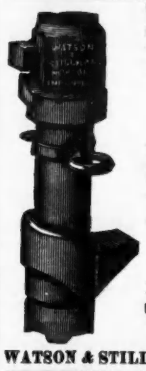

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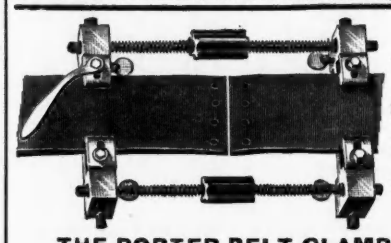

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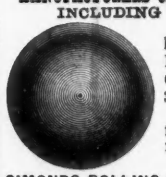

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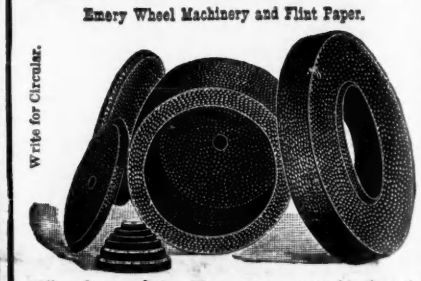

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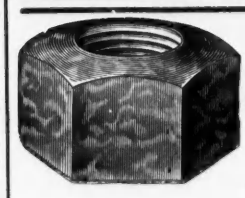

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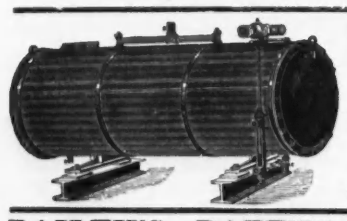

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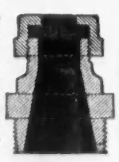

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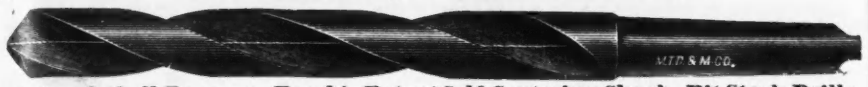

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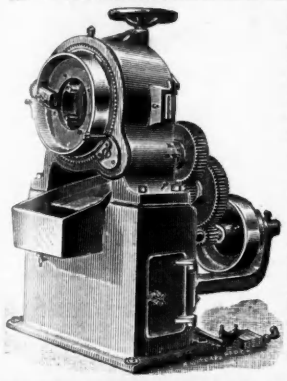

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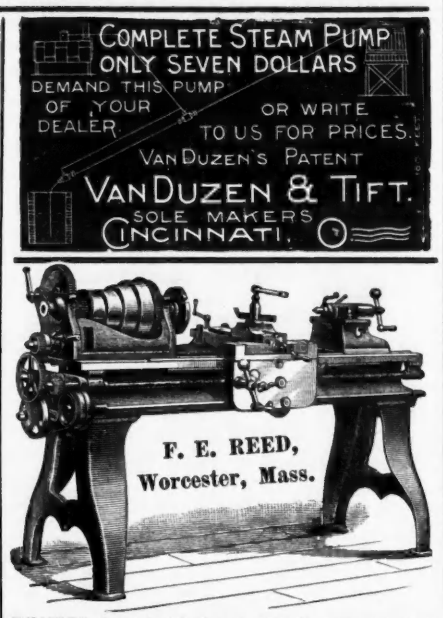

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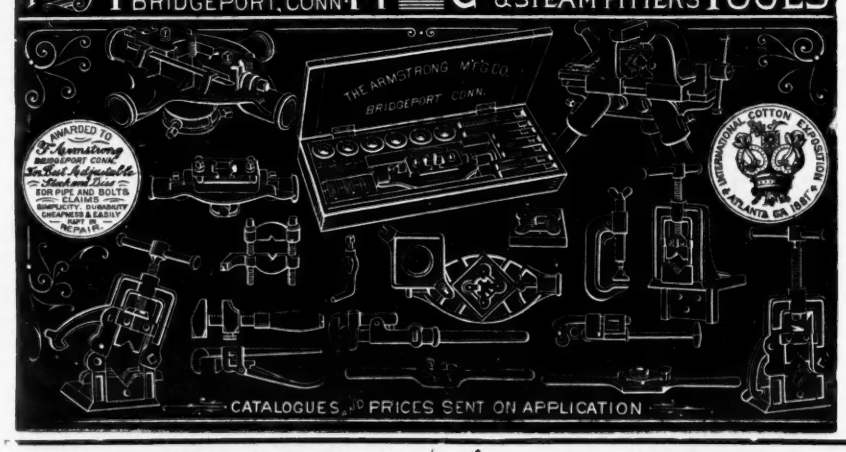

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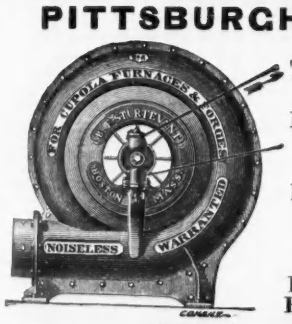

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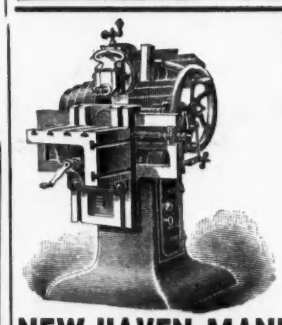

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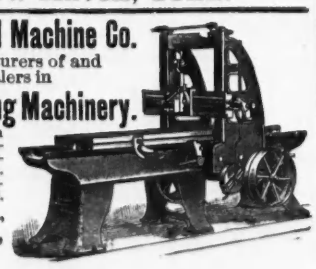

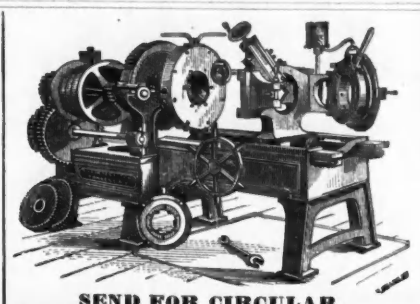

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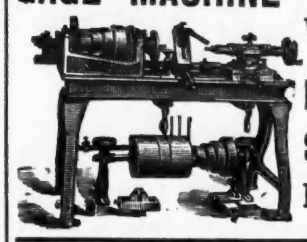

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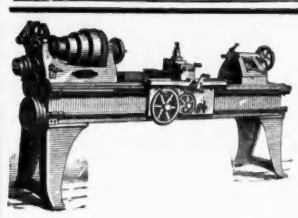

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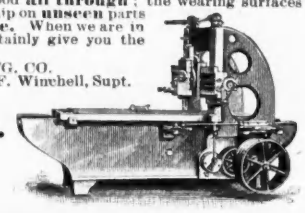

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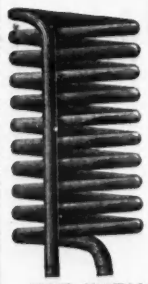

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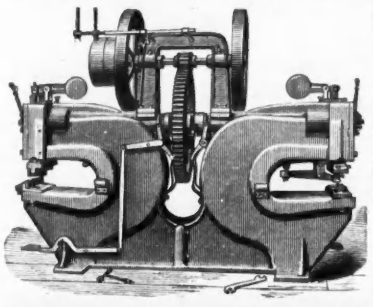

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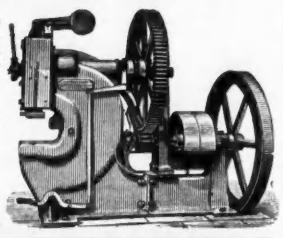

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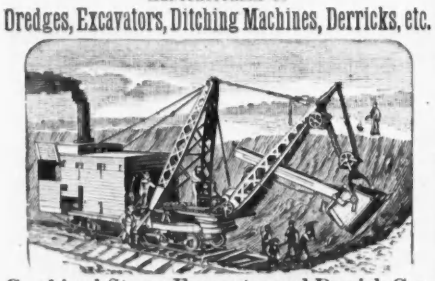

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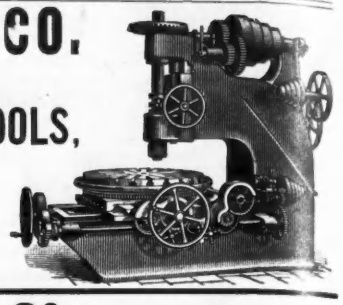

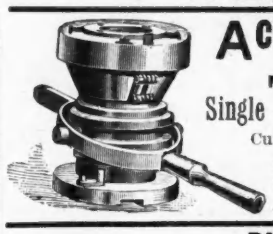

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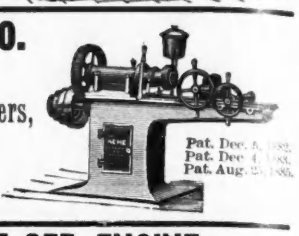

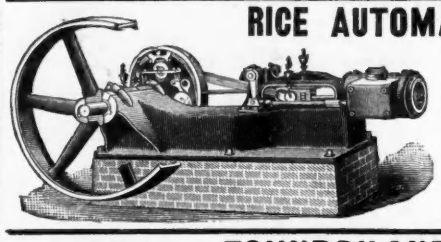

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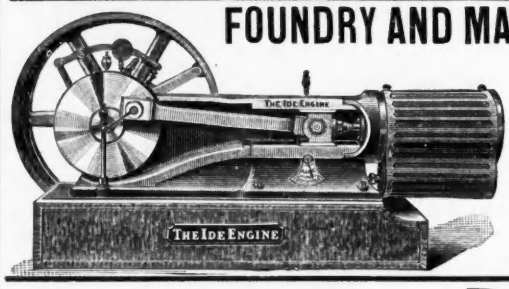

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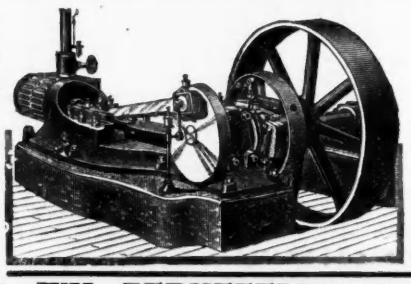

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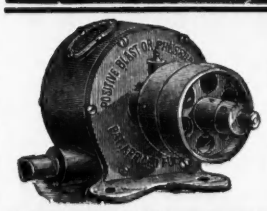

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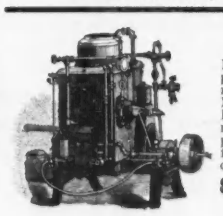

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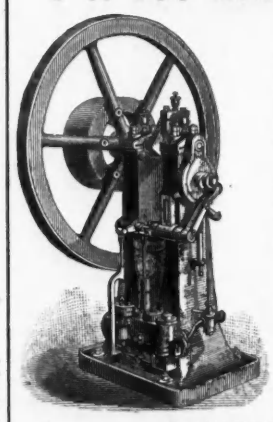

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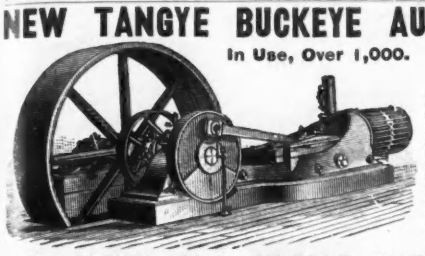

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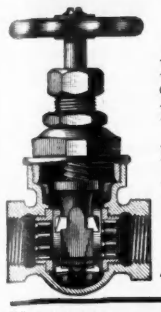

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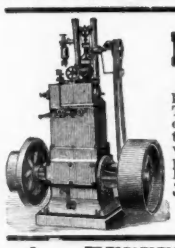

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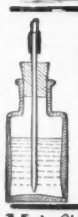

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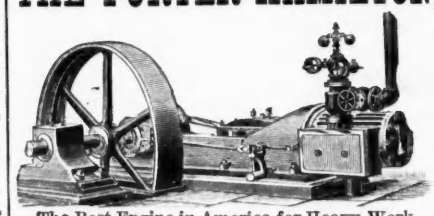

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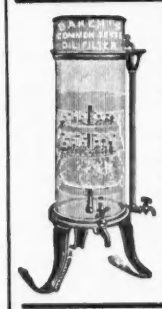

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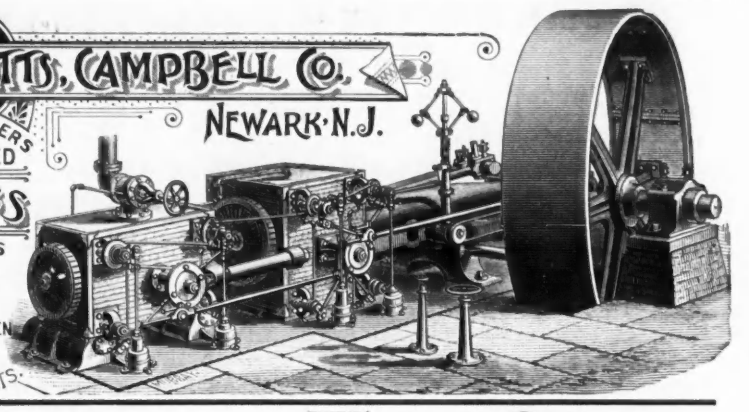

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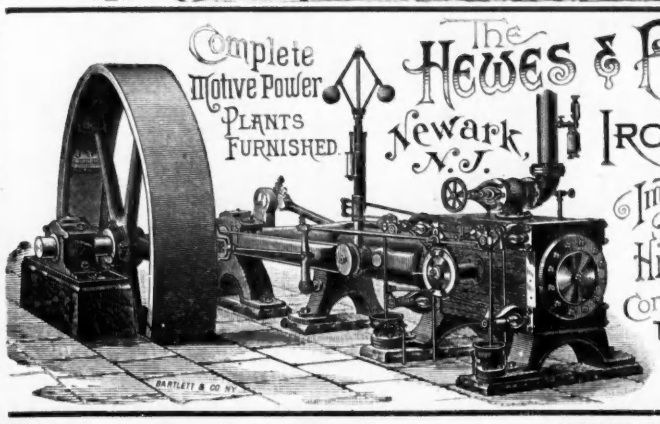

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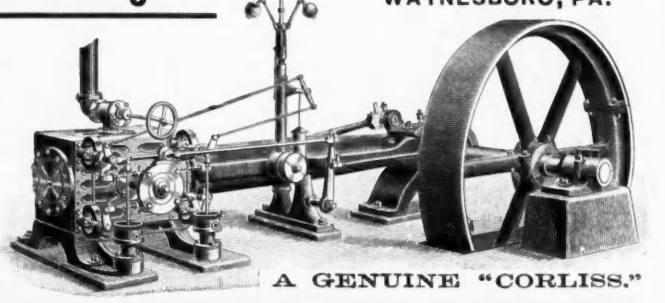

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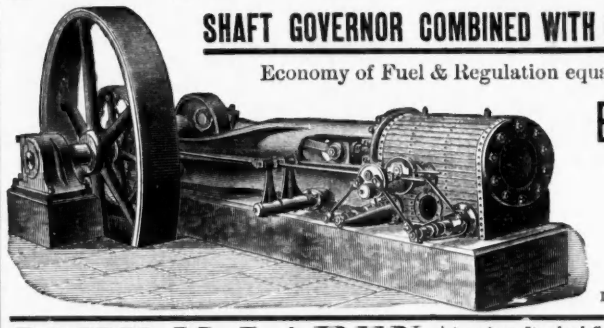

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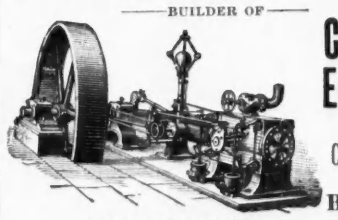

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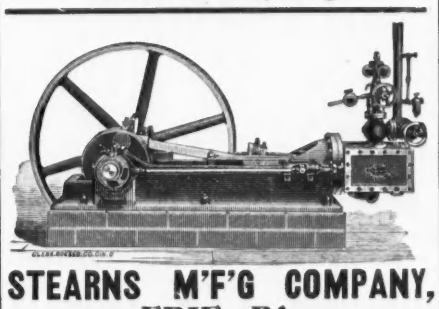

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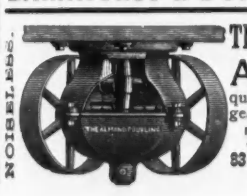

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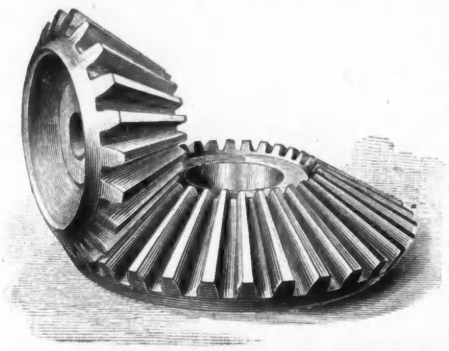

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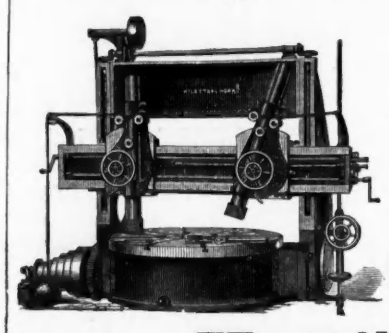

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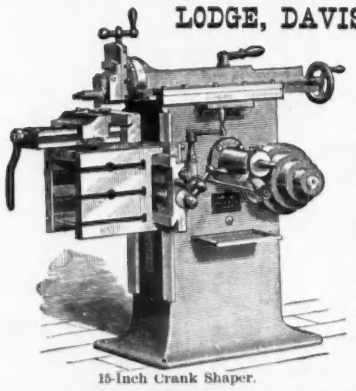

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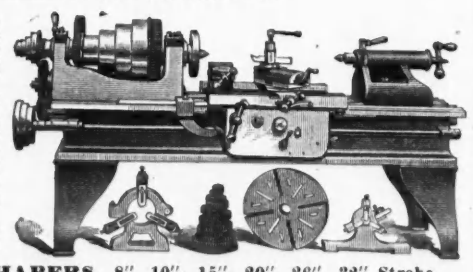

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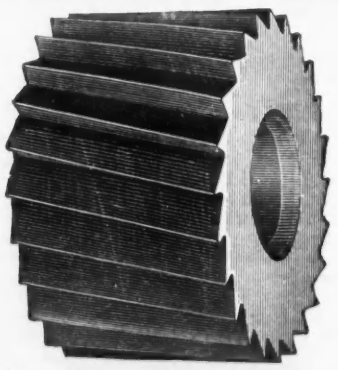

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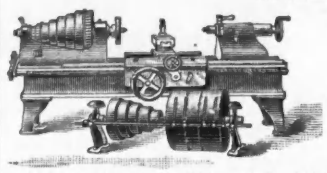

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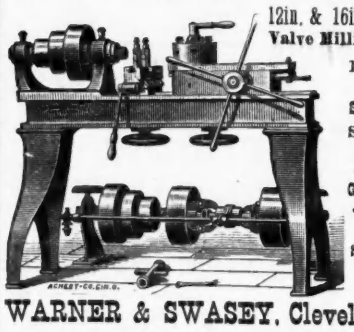

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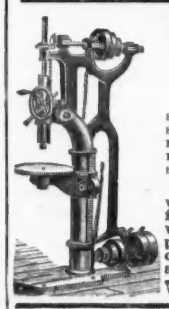

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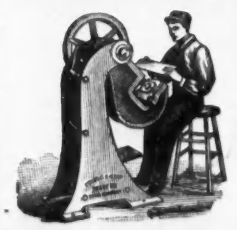

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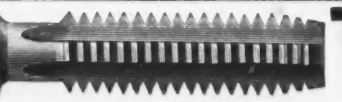

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